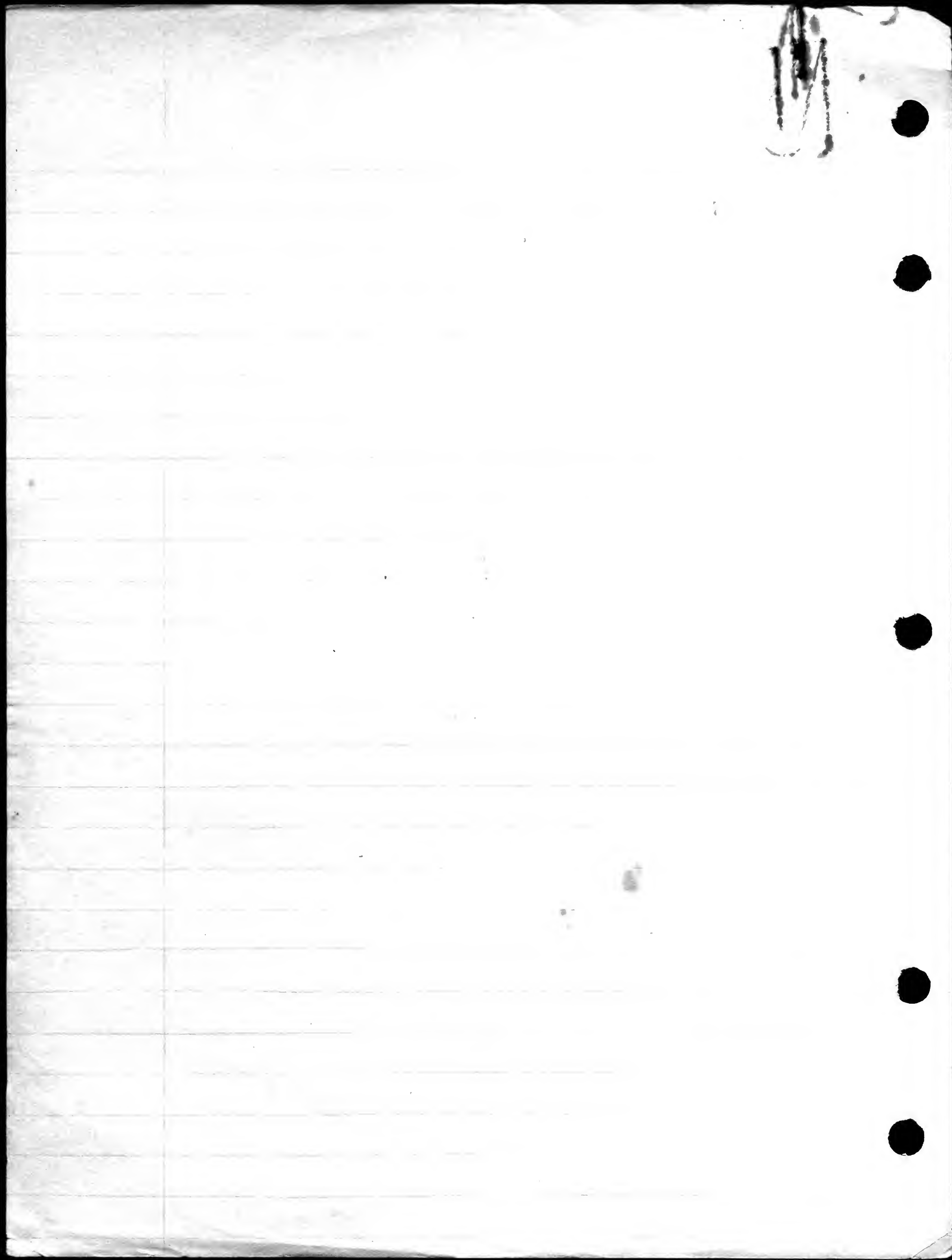


121
M

XI

Induced by display



March 9, 1944
San Blas

Arrival of Halimuga at night. Running near light.
t.

Ca. 7:20. Single Dory shows up. & she leaves immediately. Some more inds. later. SAN

March 10, 1944
San Blas

Sunny and windy this morning. Going to start at Halimuga. Aquatics starts shallow tow 8:00. All around island. Fishing. Then along off shore ridge 8:25. Find group of 30-40 young Sepiots. Mostly small. A few small-medium. 2 ft up in 3 ft of water over TG. In water (patterned). Ord + Quite calm. Quite close together. Some inds. have elongated tentacles. Feeding?? On copepods? There are spotted Goat fish swimming about below. There also is lots of miscellaneous debris in the water, including Sargassum. The squids do not seem to pay any attention to the debris.

I swim away and find another semi-detached group of small Sepiots about 20-30 ft away. One ind. is in extreme HD, with extended tentacles (tips of tentacles - the clubs - are conspicuously dark). Plus extreme Box above and below. (Rors says that other inds. in group have been doing V's, splits, etc.)

Get out of water 8:45 am. A resumes shallow tow. Out

Ceph., Mar. 10, 1974 II

(120)

to shallow bank. Nothing. Stop ca 10:15

Go on to Hurliga. A shallow bank ca 10:15. Still nothing. Stop ca 11:15 a.m.

Go on to Lila. A shallow bank ca 11:15. Still nothing. Stop ca 12:15. A shallow bank along shore. Stop ca 12:15. A shallow bank. Back to another island near 3:30. Found a Sepia 2 ft up in 20 ft of water over mixed coral and sand. Inds. are large or almost large. In Ord + One does E Crawl. Then releases. 4 inds. assume 7 when they drift close to us. Pictures taken. Several of the inds. have WCA and trace of Spoke. During next few minutes, at least two of the inds. do several Curls and E's. All in Ord +. No trace of courtship. (Are Sepiots not likely to perform such patterns as E's and Curls during the non-courtship season? Possibly because they have nothing else to do?)

Inds. in Curl (possibly also in E) show a definite tendency to swim away from the group as long as they maintain posture(s). Could this be "distraction display"? Or else...

There are Gray and Yellow Goshawk swimming nearby.

A goes in to take photographs. The Sepiids retreat. Some DM in Ord + during retreat.

Then I get out of water. A resumes tow over TG flat. Finds group of 10 small Sepiots. SAN

We stop observations 4:25 p.m.

COMMENT: The water has been very cold ever since today. Is this one of the reasons why we have seen so little of interest?

Ceph. Mar 10, 1974, III

465

Go back to Reef Top in morning. Rain light. Some Sep
seen on reef top at 2:11.

July 4, 1974
San Blas

Arrived last night.

Rain light off shore. One medium (large?)
Squid showed up. Still on track on new small organisms. SAN

Start out at Malaga in morning. Sunny. Windy. A
starts shallow tow ca. 9:30 am.

Finds 16 small Sepiols almost mixed. High in 3 ft of
water over TG flat. In End + WS + PCA. Also Pointing down.
The two nearest inds. do Forward V's. Then one does Split.
Both probably in Double streak at the time. Then all inds. relax.
Sink lower. All in End +. Still Pointing down. Tentacles some
what extended.

Then there are more V's and Splits when A approaches to
photograph. Displaying inds. clear below. With some Fox Stripe.
Probably also Double streak. Inds. retreat. A follows. I get out
of water. A stops observations 5-10 min. later, ca. 9:45-9:50.

NOTE: This area looks eminently suitable for a "nurs-
ery". But I think that this may be the first time that we have seen
young Sepiols actually using it.

A resumes shallow tow. 10:00 am. Area of reef on mainland
side of island. Finds group of large to medium large Sepiols. Pro-
bably at least 16 inds. in group as a whole. More or less divided into

Ceph. July 7 1945

(465)

3 subgroups. 4 inds in nearest subgroup 3 ft up in 12 ft of water over mixed coral and sand. All in Ord +

There is a large Gray's Yellow Goutfish just below this subgroup. Feeding peacefully on the near bottom. The squid drifts along and the Goutfish follows.

The largest ind. of the subgroup shows brief bursts of E's. All inds. swim away rapidly. Without making any sound. But possibly mildly alarmed. Following things in E's. That is, they very much want to surface. Sure this is unusual E's?

One ind. approaches sideways. Extends arms and legs forward. But does not strike. Note. Most Squids are very cautious about striking at large prey.

Then all inds. sink low in water again. Several do E's. Why??? All still in Ord +. Then the largest ind. does Pie in ordinary swimming posture again. He rises. Back to Ord +.

Subgroup drifts inshore, then out again. From C. in other subgroup (at least 6 inds.) Some inds. do E's and Point Up in Ord +.

One ind. suddenly dashes at fairly large fish. In Yellow-ish mottled pattern with Point Up. Apparently "territorial defense" rather than feeding. Fish retreats immediately. Squid relaxes. Back into Ord +.

Then same ind. does "Yellow" - Point Up to A where he swims nearer to photograph.

Another group of 4-5 inds. react to A's approach by sinking down to Staghorn Coral. Flashes tail to coral.

Ceph. July 7, 1974 III

(467)

All in Ord + some to front lip. This is very reminiscent of
specimens from the 1960s. Obviously cryptic and/or mimetic
forms but all together and drift apart when A
leaves.

A few minutes later, 5 or 6 from 4 or 5 other inds
All to the "Yellow" - mottled - Ord + One with trace DM.
COMMENT. I think that "OH", "Yellow" and "Yellow
mottled" may all be the same thing, or no more than variants
of a single pattern or a single kind of intergradation between
Ord + Ord 2.

Then we all go swimming around Achutupo (Litt
le Thalupo) and wreck in channel. Nothing of interest.

Stop 11:40 am.

This afternoon we go to Panatupo. A tour back and
forth in front of Panatupo, then around Pinautupo, then
around Quiriquitupo. David and I swim from time to time in
various places. All ca. 1:45 - 4:00 pm. Water usually very
murky. Obviously the weather has been disturbed for some
days. Wind still strong. We do not see much of interest.
Only some blobs of ink near drift line over deep water
in front of Panatupo.

Running light from boat at Panatupo at night
SAN. (One ind. Sept. One group Dory).

July 8, 1974
San Blas

Still at Panatupo.

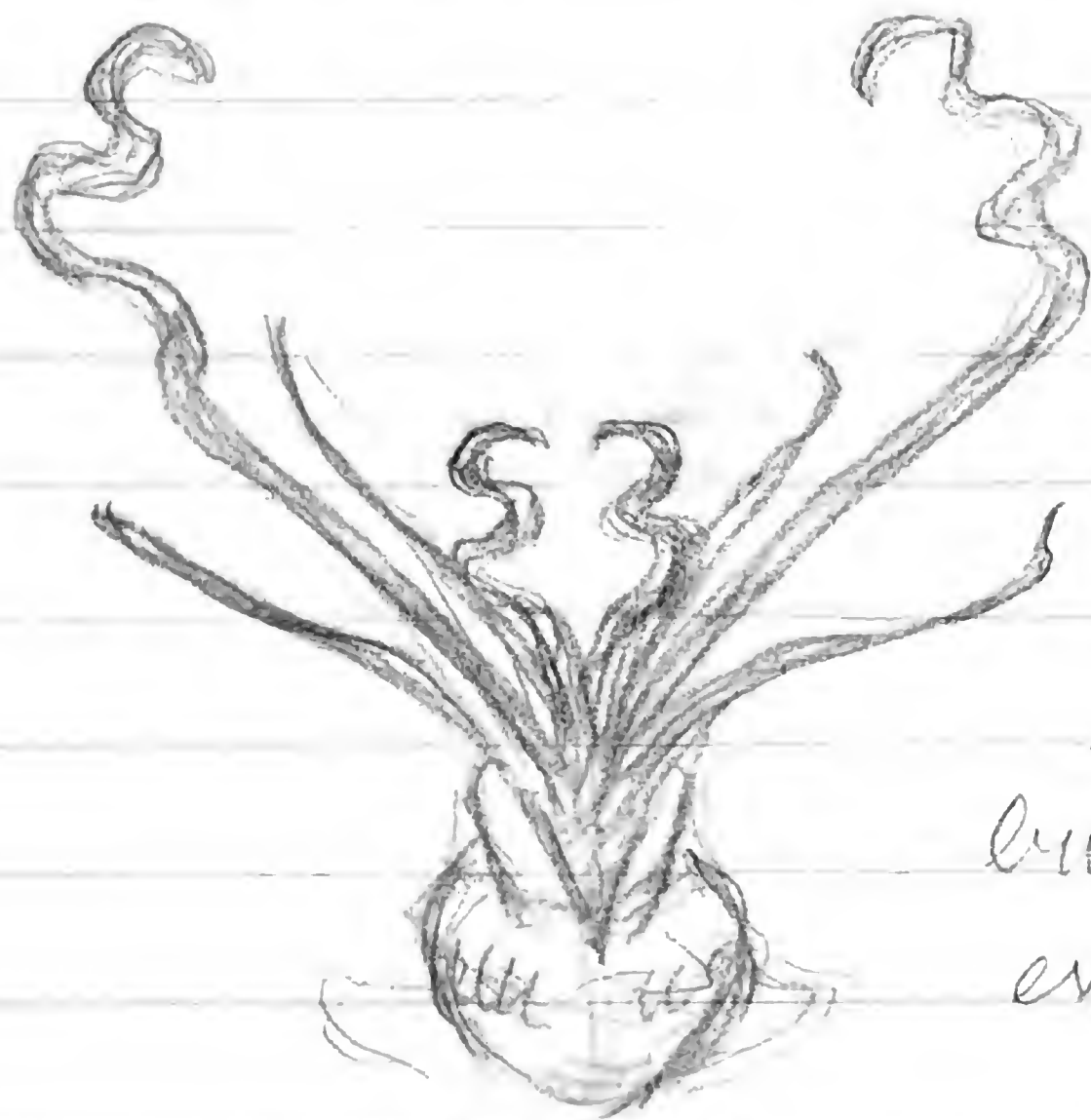
Ceph., July 8, 1941

458

A starts tow around usual areas 7:40 a.m. In overcast. There is less calm. Water clearer than yesterday. We go back and forth. No luck. Stop 8:00 a.m.

Over to Puntales. A and O being (spearfishing) off the (point) reef. A sees young Sepiols almost in sight. In shallow water, TG flat. The young fly away, always.

We all swim around looking for them. When C sees some near boat. We rush over. Find 3 medium Sepiols. Halfway up in 3 ft of water over TG flat. All 3 in. or less Bar (NOTE: Bar in low water), with more or less fin stripes and/or trace of streaks. One ind. does superb Contort. Come up.



Perhaps perhaps not as symmetrical, but possibly even more exaggerated.

These 3 inds. dash away. We follow after. Then we come across a group of approximately 60 inds. Ranging from small to medium (quite smooth gradation), plus one some-
large. Halfway up in 5-6 ft of water over TG. Quite close together (6"-2' apart), strung out more or less in line. All more or less in Ord+. Drift away into slightly deeper water,

Ceph., July 2, 1974, II.

(467)

then back into shallows. Young seems to be relatively tame (perhaps, but greatly disturbed when Aglotes. Only a few do "small" jumps. Female II - the other comes particularly by here)

common. This is not a common behavior in this area. (perhaps a sign of juvenile)

We step down from the sand and assume shallow tide.

A few minutes later, Aglotes & large Sepia. Really quite close to where young were few minutes earlier. But bottom here is mixed sand and TG with lots of isolated coral heads. When I get into water (rather tardily) the 2 squid are 2 ft up in 4 ft of water. Engaged in full "courtship" with copulation attempts. Female is quite conventional in some ways. Pair rocking together. Male makes many passes. He is usually in Parallel diving passes. Much fluttering. Female usually responds by shooting upward and backward in Pic.

There are also some points of interest. Female frequently shows conspicuous Belly-spelling (Speckled Belly) diving and at height of rise. This must be visible to male following below. Spots quite large (at least as large as when Belly-spelling is combined with Z by ♂'s). This pattern must be "repellent", probably purely hostile. The ♀ never did Z with her Speckled Bellies this morning. At least once she was Pic on top when Speckled Belly below. Several times, she was PH on top. (NOTE: these PH's were not particularly yellowish. There is a real difference between "Yellow" and PH.)

The male sometimes showed Fin stripes and perhaps

Ceph. July 8, 1964 III

(70)

traces of Double Strike, superimposed upon a full and flatter, when making a pass. But the passes accompanied by "strokes" and strokes probably did not lead to actual "strikes".

There were, however, quite a lot of "strikes" at various times. At least 17, good many more. Some were apparently successful. The q does not "strange" species at all while I watch her, although she does "strange" a lot of things. I see one strike, and A saw some arrangements later.

Then both birds relax. The 2 birds are now about 2 ft apart, in Ord +. A goes into photo while I get out of water to write.

A few minutes later, a third ind. appears, presumably another ♂ trying to get at q. (A dispute develops. SAN (First ♂ 2 at first. Then Lateral Silver, while 2nd ♂ is still nearby, continued after 2nd ♂ leaves.)

Stop 9:05 a.m.

Go out again 10:00 a.m. +. Over to P. area again. Sun now shining very brightly. Only light wind. Go straight to area where pair (and extra ♂) found earlier this morning.

Find single large deposit immediately. Low in 3 ft. water over TG, sand, coral. In E and Ord +. Retreats into deeper water. Then see pair, about 10 m. away from place where first ind. seen. These are obvious, the same 3 inds. seen earlier this morning. Pair are in Dark. Little or no WS at first. Then one shows more WS. Same ind. also assumes some HD.

I break off observations for 5-10 mins. Then back to pair. Still there, in same place. And now third ind. presumably

Ceph., July 2, 1944, II

4171

same "intruder". It is about 10 ft away. All in Dark. "Intruder" - see p. 1. One of pair approaches. Goes out of Dark, into Red + W + Y as it does so. Then retreats. Goes back out of Dark!

Then there is a sudden burst of displaying. I miss the exact beginning. When I catch on, "Intruder" is 20 ft away from pair. He is in extreme Bar and Curl (Again Bar in shallow water?). Also Bar on at least one side (on body?). Presumed male of pair is in extreme Lateral Silver, Light side toward "intruder" as would be expected. Female of pair is in peculiar extreme asymmetrical "R".

This is probably "winged" Lateral Silver. The only time

that I have seen a ♀ do anything of the sort. Greatest extension of light on side toward "intruder" (The positions of the 3 animals were quite conventional. The ♂ of the pair was between the "intruder" and the ♀. This means, of course, that the incipient Lateral Silver of the ♀ was directed toward her own "mate" as well as toward the "intruder". Doubtless this aspect would not be out in the context.) Joint "defense of territory" ???

"Intruder" leaves almost immediately. Apparently, actually "repelled" by Lateral Silver. Lateral Silver seems to be very high intensity and effective threat.

NOTE: It seems to me that today's observations suggest, very strongly, that Bar is either higher intensity and/or contains relatively more escape, than Streak (on the average).

Then we stop observations of these animals. Go on a

Ceph. July 8, 1948, I

440

hundred m. or so, find an octopus *Uroteuthis* vulgaris. When first seen, it is in very shallow water (less than 1 ft deep). On bottom. In T.C. A few inches from end of beach. A large bluish crab claw protruding from under web. I.E. these animals hunt by day.

I Animal is in ritualized "dull" or "gray" pattern. More or less greenish gray. Large and tubercles on back. Arms in apparently unritualized positions. All movements slow. Parkard and Sanders. Animal is apparently "trapped" and cut off from its home. Does not move.

II A and O start photographing. A nudges the animal. It immediately changes color. Goes Baler, still with some traces of mottling (and possibly papillae). And gets "Side Streak." As in A's photos of capture inds. in Lab. Streak on only one side. This side actually nudged first. Streak color dark brown. Strongly dark, and clearly defined on face, in front of and under eye. A little irregular blotching above eye. Coloration along side of body is sort of vague and irregular. Presumably does not reach all the way to the rear tip. Arms are still in unritualized positions, but now definite, barred.

Animal continues in this way for some time. Gradually cooing out to, or trying to reach, deeper water. Keeps side streak on same side, even when surrounded and approached from other side!

NOTE: Eyes seem to be raised on stalks throughout this period.

Crab claw also continues to protrude throughout.

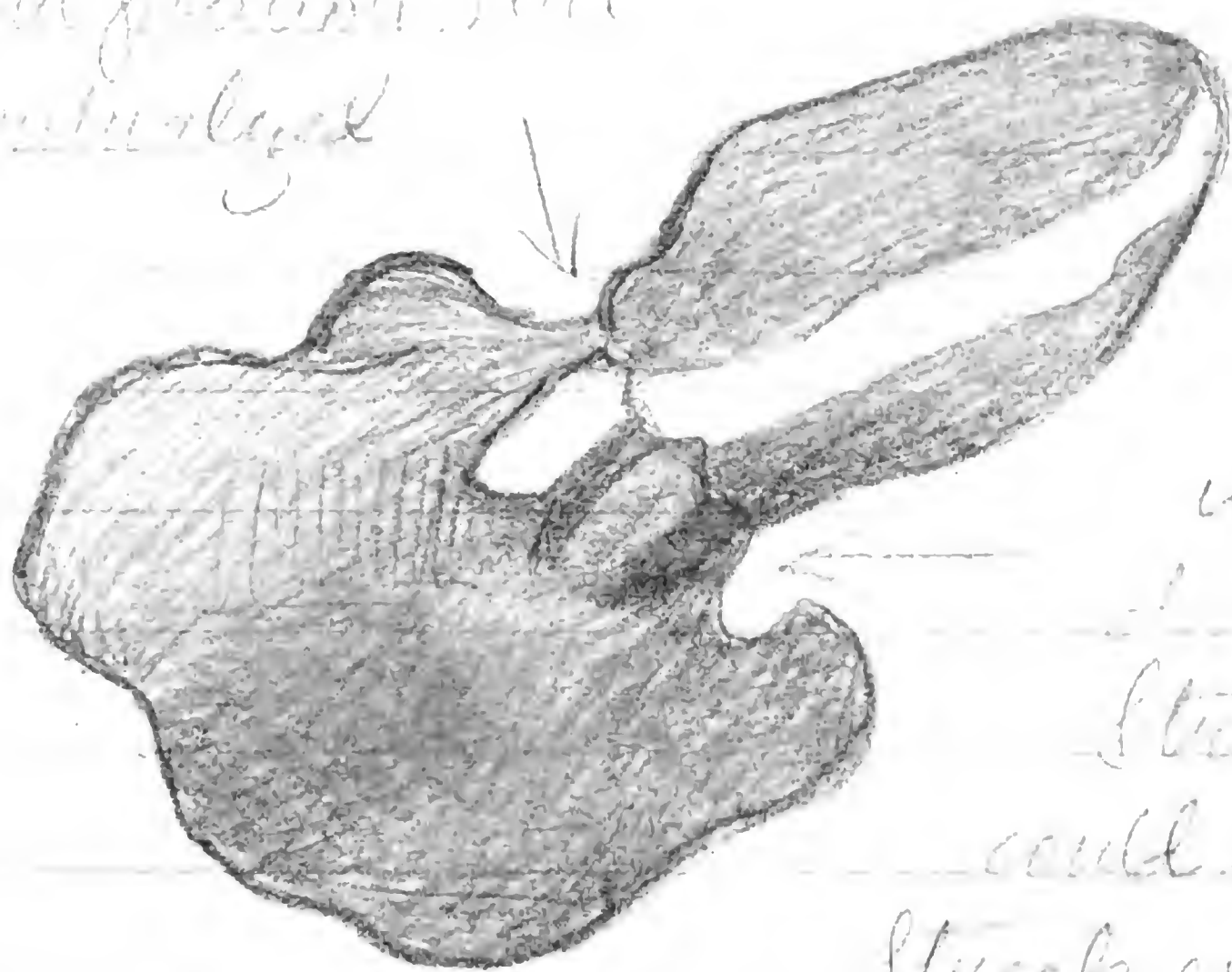
Ceph., July 6, 1975, I

(473)

Then continuing to retreat animal suddenly adopts "light strike" posture. Head, arms, and middle parts of trunk become dark brown. Bright fan shape of arms pale color, probably almost white, or very light brown. Light brown down center of trunk, arms, and head. The whole body definitely "light" color.

Arm position still unchanged

Probably still with papillae



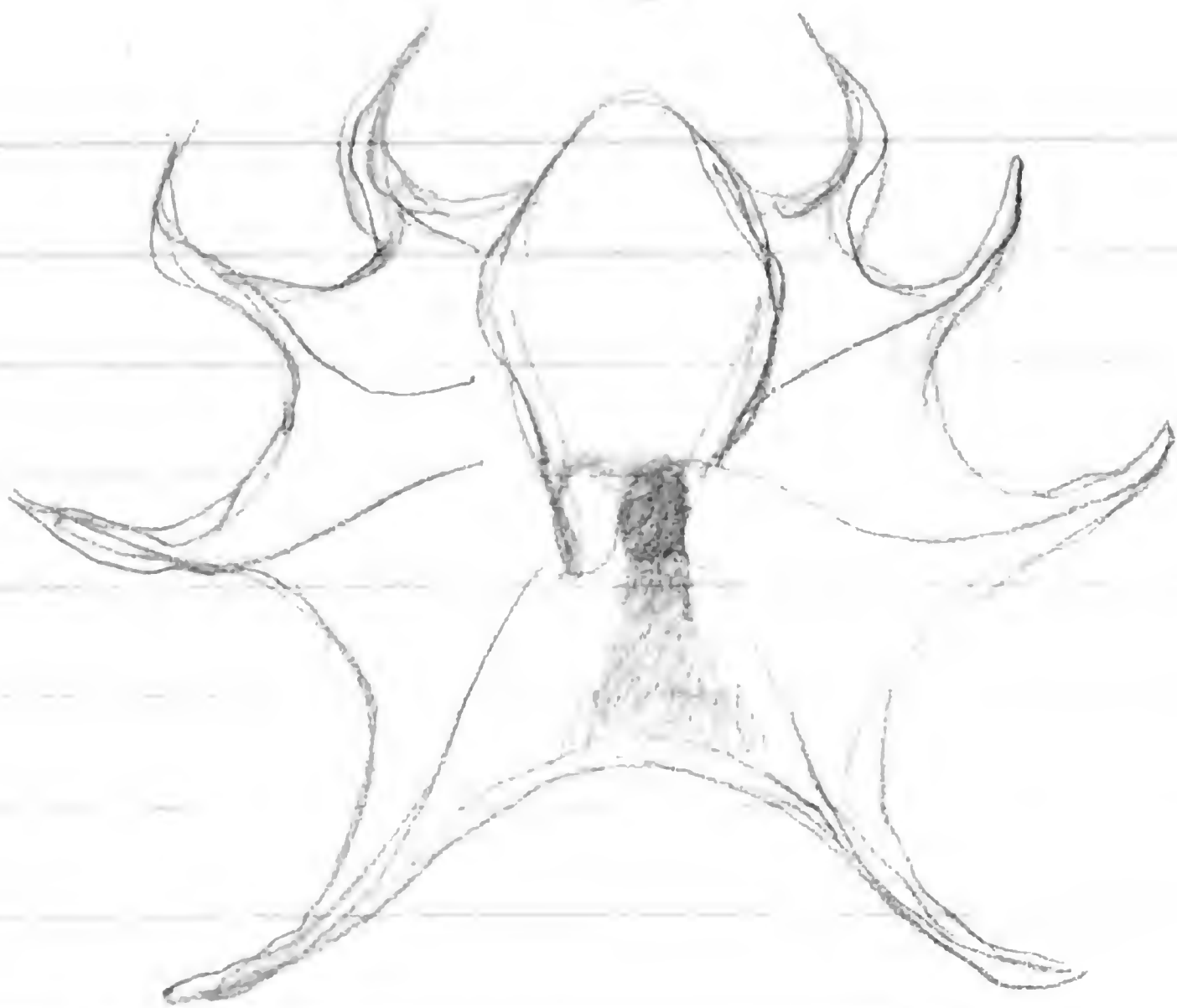
The eye that went light was not the one that was dark in the preceding side strike. In actual fact, one could still see a trace of side strike even during the light strike.

Strike. Almost as if light strike and side strike were extremes of the same coin — or at least extremes of a continuum.

IV Then the animal starts to retreat much more rapidly. Still crawling. But with arms and web fully spread. Portion highly ritualized. Animal generally very pale all over. Except for dark over eye (this time same eye as in side strike), spreading in fan over adjacent part of web between arms. Skin probably smooth throughout. No papillae. More or less comme ça:

Ceph., July 8 1974. III

471



VI Then animal suddenly shoots away swimming by jet propulsion. Animal vulgar was swimming pasture (i.e. compare with macroopus) Entirely Pale throughout. Apparently no markings of any sort.

+ Animal continues to swim rapidly. I can't follow it, as I am in boat. But O and A swim after it, taking photos. It goes through several more color changes. Cryptic by rock or coral. Brick red flush just before darting into hole or den. SAN

COMMENT: This octopus obviously was hunting far from home. Its den is at least 10-15 m. from where we first encountered it. Presumably a permanent den. Shells scattered outside.

I come back to ship ca. 11:45 a.m. C and A continue swimming and towing. Find more young squids around Pinnatipo. SAN.

We go on to Equisulap in afternoon. Still going

Ceph., July 8, 1974, III.

(445)

calm but now overcast. A. starts shallow tour around island. Finds 4 or 5 large Sepioteuthis in reef area and many L. dorsalis in water.

At 10:00 am. A. starts at West 17 Septs. Moves down low reef up to 10 ft of water, over reef, large by 11:00 am. 6-7 of the same in the water. The rest ran off to large 200 ft off in the water. So Pic.

At 11:00 am. A. starts shallow tour. Finds 10 or 12 dark, green Pic. 7 or 8 yellowish versions of Octopus with much flattening. Several of these. One of the apparently successful. Both animals drift off in Oct.

At 12:00 pm. A. starts shallow tour. Finds a few minutes later. Discovers traces of Lateral Silvers, Puffers, more Pies. But all were faint and sluggish.

A. continues. At 1:00 pm. A. goes all around island without seeing anything more of interest. Finish around 4:20 pm.

Running light at night.
Nothing.

July 9, 1974
San Blas

Still at Oguzuk. Cloudy and windy at dawn. Lots of Sargassum in water.

A. starts shallow tour usual route 7:50 am.

8:02. Finds 3 large Sepioteuthis in reef area, over Staghorn.

Ceph. July 9, 1974 I

(40)

annoyed with a great diversity of fish. In C. & S. ...
malint, and disappear. Later on, A cat is glancing from the ...
ge Sept. Bar, C. V. 500

Then find 3 more large schools of ...
ft. down in 1 ft. of water over sand coral. In C. & S. ...
Gradually drift out toward deep water.

We swim around for a while. Stop observations 8:50 am.
Go on to Mergapaya. Weather is clear, sunny, blue sea.
A starts shallow tow 10:30 am. Find along shore ...
(lots of TG), then around island (along reef), then over to ...
Natupe. Nothing of interest.

Then over to long offshore bar or bank. A ...
out immediately. We all get into water and swim around. I ...
e across group or sub-group of 21 or all sepiots. ...
line. Halfway up in 3 ft. of water over sand TG, and Diadema ...
in Ord +. Very good. Then I find another group of ...
small sepiots a few yards away. ...
finds more small sepiots in same general area. The whole group ...
water of groups may include 50+ inds.

Some of the smalls are fairly "large". Others are tiny.
But none looks at all "larval".

This is (still) a good nursery.

We get out of water 12:00 Noon. A continues shallow tow ...
along bank. Gets brief glimpse of 2 large sepiots. I ...
for them (?). Then over to boat.

Stop observations 12:30 p.m.

Then over to Naranandupipi. Sunny and windy.

Ceph. July 7, 1975 II.

(4747)

now. A starts to tow and we are about 2:30 pm.

There are 31 young Sepiots almost immediately. About 1 ft up in the water. Over sand and it is clear. Some of them are in the line. Some are in the line and some are in the line. (All the ones in the line are together. All in line + A swims into the line. The nearest one is a Juvenile and the one in the line is a Juvenile. Then the ones, goes back into the line. A few minutes later, several more, some Juvenile - (Some of them are whole group of ones. Apparently frightened by jack). When we approach the squid again, they string out in line. I think they are more nervous now than they were earlier. Still still in line.

We break off and move on.

A little further on, same environment. A sees group of juveniles. They disappear immediately. Apparently frightened off when Carlos sets propeller in reverse! Is this hearing?

Then we find 14 young Sepiots in similarly shallow water over sand and TG.

Go out along coral reef. Find group of large Sepiots 2 ft up in 10 ft of water. More or less over "valley" of sand and coral debris between two patches of living reef (*Acropora* etc.) In line. Do several E's and Curls. Then we see that all or most of the inds. of the group are feeding actively. On rather small green "sandwiches", assembled in huge schools, usually slightly in front of the position of the squids. And this feeding is accompanied by remarkably elaborate display behavior by the squids.

Ceph., July 9, 1974 III

Watching one ind. Group of squids in sand. While sand was the near surface. One squid in semi-Pale (or Pastel - Salmon). With DM (on fins, probably, extending out to edge of fin). Then starts forward and back. Starts out to fish. Then drifts backward and down. Starts to eat fish (apparently very rapidly).

Then there is a change in the group. All turn a few yards. All turn Pale. Then some. Resume C. etc.

One ind. does E and then DF in C. etc.

Back to feeding. Again approaching sand from below. One squid swims diagonally backward and upward. With DF, in Pale, with DM (as before). Then BB. Then suddenly shoots out (tentacles forward, sideways). Catches fish. Swims forward, swims, swims, swims. Under End +. (Note: The belly seemed to be clear through all these displays).

Then see more feeding attacks. All with prominent DF, Pale or semi-Pale (Pastel), more or less DM (on fins and/or body), and definite BB. Tentacles usually extended just before strike. When and if so, the main body of the arms and tentacles is dark, but the tips of the tentacles are white (could this act as a lure ???).

COMMENTS: These semi-Pales seem to be indistinguishable from Pastels. I.E. Pastels are only lower intensity Pale. The difference is quantitative rather than qualitative.

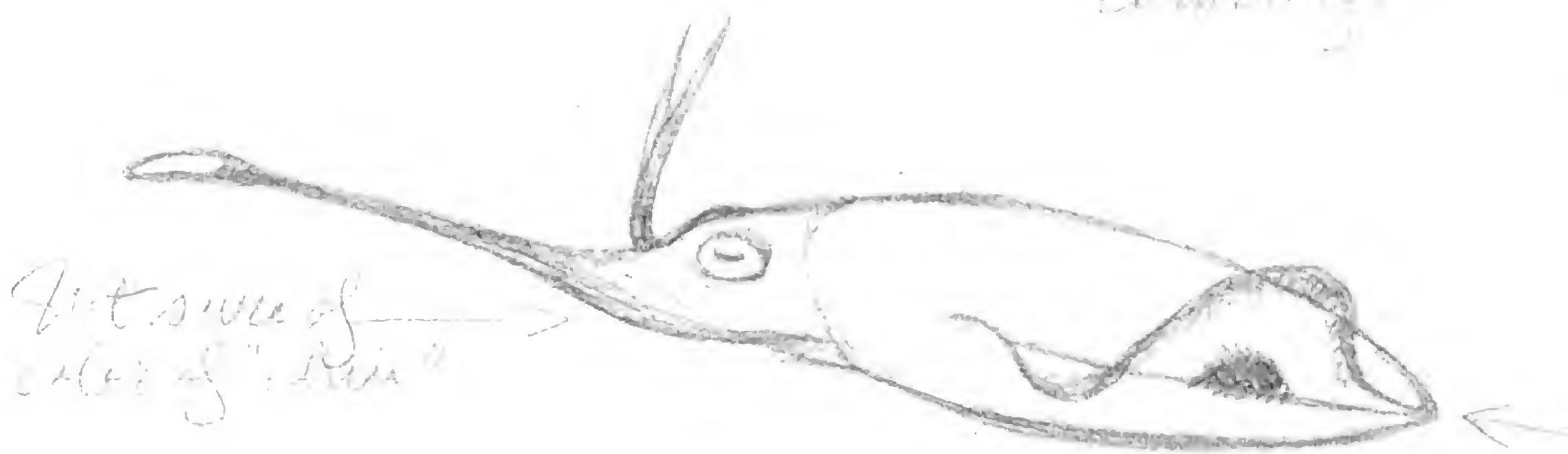
All or most of the DF's are extreme. But straight up

Ceph. July 2, 1971

(479)

After dark

General effect more or less
common



Not sure of
color of "fin"

Perhaps of the
same color as
the body, but
darker.

Saw one P. by one more feeding end.
Then back to feeding again. Takes at sardine
always present by feeding. Then slow as above (I am not
sure that I saw it). By more than 2 or 3 separate ends.
But A says that all the members of the group were behaving
in exactly the same way. The other strikes that the fins were
usually or always held up just before a strike, SAN.

Sometimes a squid performed even more elaborate
displays while approaching a sardine. Usual DF, Pale or
Pastel, DM, and BB. Plus Cirl (an exaggeration of DF?)
and/or E. But I think that these approaches were "inhi-
bited". They did not usually lead to an actual or success-
ful strike. No capture.

We interrupt our observations. Come back in about
10 min. (ca. 3:30 p.m.). Same squids in approximately same
place. Not feeding at the moment. A large school of chub-
(?) swims by. Squids dart back a few feet. All turn extr-
eme Pale during retreat. Most also do E. At least one
also assumes "quadruple" DM. And one does Bar after
Pale. Then all relax. Back into Ord +

Ceph., July 9, 1974, V

729

COMMENTS:

This is good evidence that E is quite high on the alarm.

DM obviously is completely confident in his body. A saw one "quick" in which the "eyes" were visible only from below, not from above.

Then a single Chironomus enters the display. All the squid dash away. I don't see the display.

They come back almost immediately. All in Ord +. Start feeding again. However, some before. The squid approach. Only DF, BE, and slight 100% of 100% of these approaches are successful.

Then more approaches with E's and Curls.

A takes photos. I get out of water.

A resumes tow. Far side of island. Finds 45 (1) large Sepiots. 2 ft up in 15 ft of (murky) water over rock between reefs. At first in line. Then group of 2 "break up". All in Ord +. Then see some Pies and other signs of courtship. One ♀ is being courted by 2 ♂'s. She is noticeably larger than either. The "alpha" ♂ follows her closely and makes repeated passes. The "beta" ♂ follows at a distance (2-4 ft). I don't see any actual copulations or fights.

There is a Spotted Goatfish below the group.

COMMENTS:

Sepiots are incredibly abundant here. Why?

A suggests that it is because this island is near Piedra Liza with "Mooney's Calanus". Perhaps the predator fish have been

Cephus, July 3, 1975, II

(481)

counted out?

The birds seen today were surprisingly numerous. One bird seen in the middle of the water. They may hardly have been in the water. Perhaps they were water skimmers? Have they also been collected by skimmers?

Plumage light. Bright. SAN.

4:20. 2 or 4 large flocks feeding close together. Some times one 1-2 ft apart. All feeding lots of small fish. But not that is a lot of no display among them. (The species is small, new, but good to see.)

Feeding much more rapidly than seen. One squid taken 3 feet in 20 seconds.

NOTE: We have seen interesting aspects of feeding here than anywhere else. Are the numbers of the local population particularly large? Large because the population is so large?

NOTE: There are four large groups around all evening. One feeding, then resting near bottom. When feeding in 11, 12, etc. Little or no Bar. Very few other birds. And the other birds come in only briefly after the "permanent" four have begun to rest. The others also sometimes in Bar. Does this suggest territoriality even at night? Do the four really "own" this area????

8:55 pm. Four have now suddenly increased to eight. Reminiscent of two sub-groups. Is this the group of 9 that we saw this afternoon?

Stop 9:05 pm.

July 28

Still at Hinnakunage. Rain
 then cloudy and windy. A starts shallow. Then 7.5 m
 along our shore, over sand, etc. There is a group of
 immediately finds group to large by 10 m. A group
 group watched yesterday. (One of group of 10 m. group (Bar)
 also including four at lights last night).

By the time I get in water, animals are
 into shallower water over mud reef. Half way up and 10 m of
 water. (Note: the water is now brown. (see note) All in 10 m
 A approaches to photo. All birds drift toward surface. All
 into Bar (above and below). Some do curls - subjects

Then they suddenly all dark downward in 10 m. 10 m
 2 Pelicans fly overhead. (This is first definite movement
 that I have seen.)

Then they go back to Bar when A approaches again.

At this point, the squids are 20 m. It forms a small
 school of sardines. Probably because we have been driving them be-
 fore us. They eventually resume Ord + gutters and curls
 around bait toward the sardines. One ind wrinkles tentacles
 without color. Several others make tentacle advances toward the
 fish. Again without color changes. But probably with some exten-
 sion of tentacles.

Two inds. advance toward sardines (again). In
 Ord + with trace DM above, Bar (2 main bars) below. Tentacles

Ceph, July 10 1974 III

be characteristics of all four stages — common in

~~mechanical~~) Bell's stage is characterized by
Upper and lower bellies (L & B)
and (probably) RL. Bottom out. RL is a d. and
Spotted Belly. The two inds. maintain their position. One ind. then
Is then drift apart and relax. Back to Bell's.

A few minutes later, all inds. are swimming peacefully. If it involves same or different individuals. Two inds. are swimming
g apparently peacefully in Bell's and several fish are swimming
near purposefully and directly back and forth. Approach
er in Bell's with RL, WB, Pale tentacles, and Faintly
into approached (who may have been in Bell's all the time?)
into flank, toward rear. Then slips below the approacher.
In more or less usual dispute position. Does Z with spread
No Spotting on belly. The individual approaches and becomes in
to, now upper, retains Bell's and back in the stage. The ind. also
also does slight spread. Then the two inds. separate and relax.

As far as I could tell, this was a quite unprecedented "attack". See also comments below. (Both inds. appeared to retreat)

Now all the inds. are swimming peacefully. Occasional
RL's. See Pic in distance. Some RL's accompanied by WB. Others
apparently not.

Back to feeding. Some approach intention movements with
simple Pale, probably nothing else.

Another "fight" in distance. As far as I can tell, it
involves only 2 inds. Lots of Z's and spreads. Can't follow details.

COMMENTS: These animals seem to be remarkably quar

Ceph. page 10, 11, 12, II.

(48)

unknown today. Why? Of course, there is some wild courtship in water. But we are disturbed. (The 2nd animal does not seem to be disturbed by the 1st animal. Are the animals "incompatible"?)

Go back to house and talking with Layla & Cele yesterday. Be sure.

Ellie leaves at 8:25 am

One ind. in Ord + puts some back over head and seems to be rubbing back. (A. says that he saw another one of this color.)

Now I realize there are 8 inds. present.

One ind. in Ord + has had indication of black "collar" for some minutes. What does this mean?

I get out of water 8:40. A continues photos

SAN. A has seen interesting incidents that I missed.

E.g. ♀ in Pic "pursuing" ♂

Start out again 10:15 am. Weather unchanged. A starts shallow tow going around island in opposite direction from usual.

We get to area where 115 inds. seen yesterday. Find ink in water. We go into water and group of 43 Sepiots. Obviously same group as yesterday. But now I notice that not all the animals are fully large. Some are hardly more than medium. 2-3 ft up in 10-15 ft of water over sand "plain" between reefs. All in Ord +. More or less in line.

Oscis courtship at far end of line.

Ceph., July 10, 1974, I.

Animals gradually drift nearer as they do so. Then retreat a few m. in Ord. Str. to s. They go Dark again. Formation of small groups.

There are several of the flat fish in the bottom bed on the squids. Seem to be of the same species.

Then I see something new. ♀ Ord.

Notice that nearest ind. of group, still in dark, is not by bas Pk. Is this indication of very mild alarm?

More courtship. ♀ swims backward in Ord. Str. Double streak plus Fin Stripes. Then relax. Back to Ord.

On the whole everything is very placid. Certainly no fight ing here.

Stop watching this group 10.30 am. A summer totem

A little further on, he finds 2 large squids in reef. He is under the impression that one may have risen from the reef. Wonders if egg-laying is in process. When I get in water, the two inds. are 1-2 ft up in ca. 8 ft of water (bottom very rough). Both in Ord+. Not very close together.

Then A sees copulation (I miss it completely).

Both inds. back in Ord+. 6-8 ft apart. Then facing apart from one another. I note that ♀ is very much larger than ♂? Also badly scarred. Presumably old. Then ♀ Pres briefs when ♂ approaches. They separate again and relax. Facing away from one another again.

Then a large school of jacks swimming by. Squid do not go away or at least come back immediately.

♂ suddenly approaches ♀ again. Swimming forward

Ceph., July 10, 1974 VII.

(132)

some sort of dark (4-5) Bar with 7. Apparently on tiny, tiny organisms. Some little one gets tiny.

Two large Sepioteuthis all present 2:12 pm

Presumably only large ones in C

Then a very small squid comes in C. 1" or 1 1/2"? A thought that they were small. They had very peculiar patterns. Dark, light, dark, light and DM. Dark brown, dark blotch on back. Very small for Sepioteuthis!!! Could there be small Sepioteuthis? Could they be *Pickfordiataenia*???

9:01. A catches a small squid. Small, slightly larger than the larger of the two. I catch the squid. Several more large squid around now. Dark. Dark most of the time.

Stopping 9:32 pm

July 10, 1974
C. P. L.

Still at Halaugan in morning. Fair and cool. This continues almost all day. Some hot storms. At 9:25 am, we look for squids all around Halaugan, the offshore reefs, the adjacent islands of Ogasima and Mambitupo, their offshore reefs, and Halaugan. See some ink but only a few groups of Sepioteuthis:

① 10:40 am Reef offshore Halaugan. A was 8 mediums. 4 ft up in 15 ft of water, edge reef. 20 Bar's, V's,

Ceph., July 12, 1944 II

out at one end, the largest at the other. ...
placed. Gradually drift out into deeper water. ...
It up in 12 ft of water. Still to bottom. ...
sh around. Then some spotted ...
drift further out to area of sand ...

We stop observations and resume ...

7:57. A new sub ...
around for some minutes ...

Then to discover 2 large ...
th them, they are 15-18 ft. ...
surf. Edge patch of sand and ...
form a "pair" of obviously ...
phase complete, over. Egg ...
animals for ca. 1 hr. During all this period, their behavior ...
arms much the same.

Generally calm and slow. Usually ...
from one another. of considerably larger ...
is setting the course. Most of the time ...
when ... appears to be in front of her, ...
ing to her moves and ... of direction.

At first, the 2 animals stick closely to one general
area, possibly 10-15 ft in diameter.

♀'s behavior is characteristic and stereotyped. She
is almost always in Ord +. Very frequently in E (see below).
Usually swimming forward. Then, ...
she would approach ... apparently a hole in the ...
coming out of E at same time, and letting arms and tentacles go

Ceph, July 12, 1975

(491)

straight forward. Probably extending tentacles at same time. Probably also moving arms in a slight, wavy way (perhaps always wavy) the whole time "being" for some seconds - of long duration - to start with - and then becoming more and more rapid.

As far as I can tell they never actually entered a hole. But she certainly "nudged" a few more.

He stayed longer than he could. Sometimes swimming in front of some holes and relative positions apparently unchanged. He reacted as was in undisturbed Oct. Here often with more or less. Reaction to us or to passing fish. He also attacked a few F's on occasion, but never with anything like the frequency or persistence of the ♀.

I saw some other minor color changes. SAN.

The area preferred by these animals at first contains some Agavecia. But not very much. A believes that the ♀ concentrated her attention upon the available Agavecia. But she must eventually have decided that the area was not quite good enough. She started to travel away slowly and more or less methodically. Covers at least several hundreds of yards.

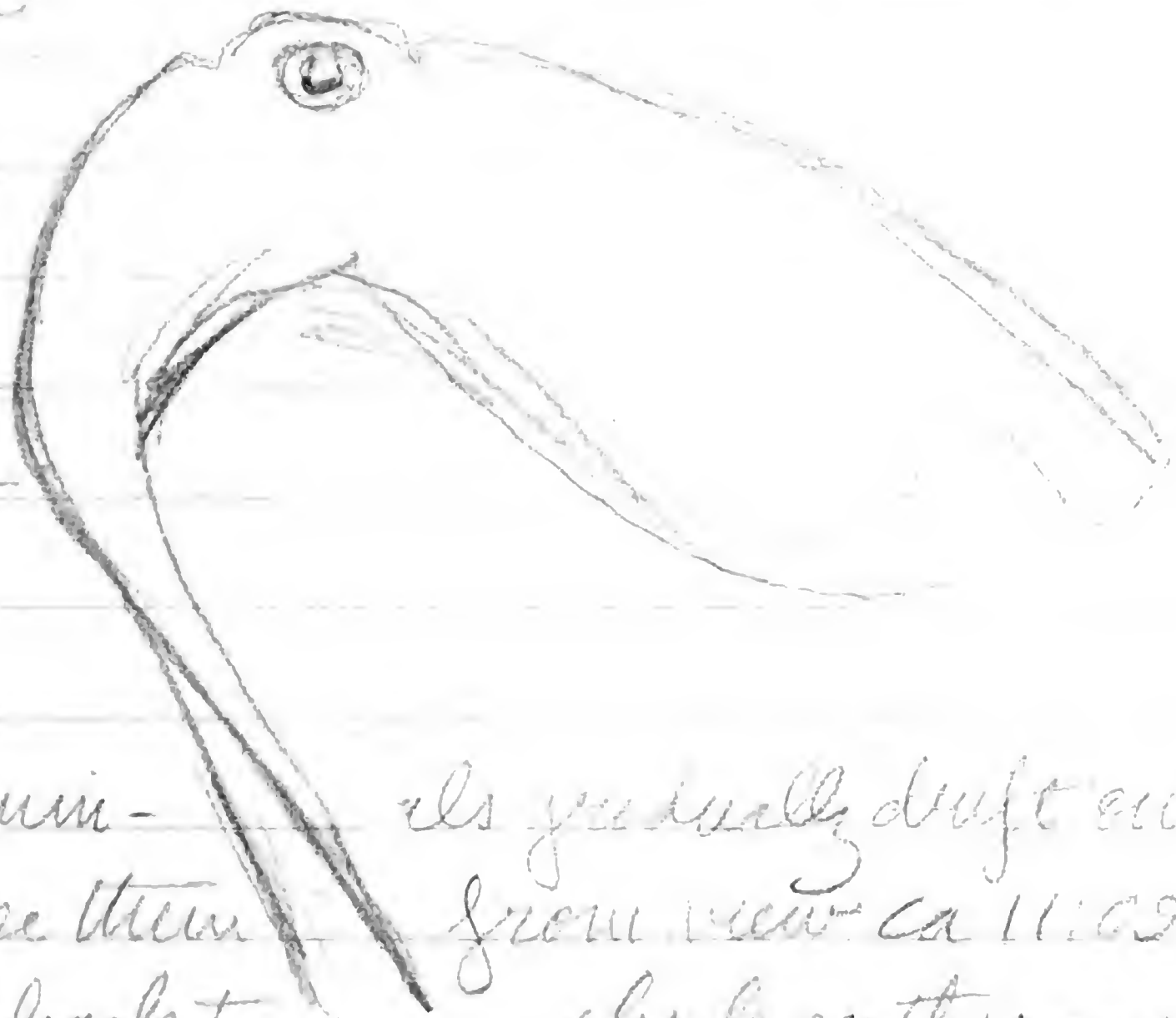
We eventually lost sight of the animals. Visibility is low here. Much. Also turbulence and refraction due to mixing of waters of very different temperatures. I imagine, however, that the animals continued to behave as before.

Obviously the selection of a site for eggs can be a prolonged process. But probably not very tiring. It does not consume much in the way of energy or resources.

Cephis, July 12, 1944 IV

(472)

NOTE. The ♀ was in E so frequently that I thought that she might be holding a cluster of eggs in her arms (at least). But later I decided that this was improbable. In the afternoon the arms (or tentacles) projected far down (and held against the body). The tips of the tentacles were sometimes 14 in. or more from the body.



Both the E's and the Bars must be indications of real nervousness.

The arms gradually drift out into deeper water. We lose them from view ca 11:05 a.m.

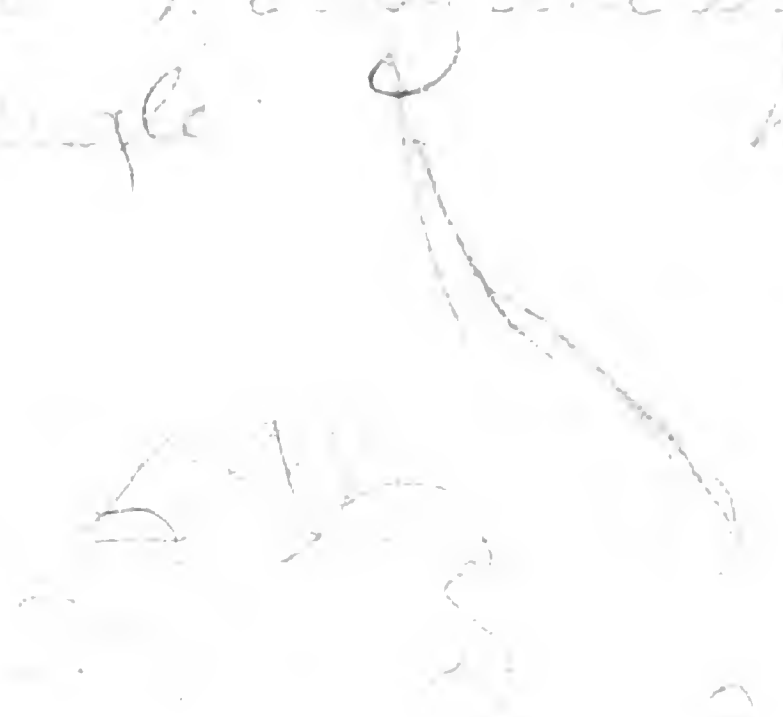
A goes back to check on this pair after finding the ♀ laying eggs approximately, same general area. I see 3 descents into hole (Mullegeth? — check identification). Near sand bottom, between 15 and 20 ft below surface. During one descent, ♀ appeared to be holding eggs in arms. ♂ present. We dash out to see. Arrive 1:30 p.m. Find ♀ hanging 1 ft up near hole. I don't see much in the way of details at first. But A sees ♀ make 2 more descents into hole. ♂ still hanging around a few ft away.

Then I focus on scene. A swims away to get camera. By this time, ♂ seems to have disappeared. (Of course, he may not have gone very far away, but he is at least no longer within 10 yds of ♀.) And ♀ seems to have stopped laying. She

Ceph., July 12, 1967

(493)

Large, apparently columnar, slightly above hole (2 ft above bottom). Head and arms slightly up. Head or less at angle.



the mantle pattern. Only on body. Skin back is largely white with 2 black mottles.

There are indications of arms. Part of back generally as in

On Oct 12 as far as tone and color are concerned. But there are also visible here. Plus double DM (probably extending to sides, but prominent on fins). Almost completely white while hanging. Only "fins" slightly up and down. Obviously due to fin movements.

Then she swims away, disappears (perhaps startled by Bill Durham). 1:50 p.m.

A goes down, finds eggs, and collects them. We will take them to lab and try to hatch them.

NOTE: A finds black pomacentrid in hole in which eggs have been laid! This is beginning to look like real and highly specialized commensalism!!! (Question. Since the pomacentrids are so aggressive, why don't they attack & squish? Or do they? They certainly don't seem to bother the eggs.)

A must check to see whether there was a pomacentrid egg clutch that we didn't watch being laid.

COMMENT: Doubtless the animals were affected by our presence from time to time today. But I imagine that the general sequence of events was almost or completely "natural." There must be disturbances of one sort or another in the life of

Ceph. July 12, 1944, VI

2074

circumstances.

SAN.

Then go over to Carl's station. Boat starts
tow and swim 4:00 pm. Still cloudy. Moon but some rain.
Go around Tule and then back. A few small fish.
That is all. We stop 5:15 pm.

Then take boat to channel near San Juan. Pico
Pico Sea. They have some sort of food but it seems to be
water. Place is called Maichubun.

The channel is supposed to be very deep.

7:16 pm. Small squid swimming bright. Presumably
young Dory. About 1 ft below surface. All pale.

7:40 pm. Two large squid appear on bright
lighted area. Don't come in further. One is a Carl. Both
pale. Could there be *Solignumula*? ??

7:46. Several moderately large Dory. Low under
whirling sandbars. With RL.

Then 2 large Sepiots. In Carl's Bay. Both are low. Both
in Carl's and E (!) More E's and Carl's when flash light
played on them.

Then another Dory.

Sepiots still around. More Carl's in Carl's when
disturbed by flash light.

8:19. Small Dory shows up. Circles with animals
at surface. Generally bright orange red. Then to see
white on flanks, leaving red center stripe, streaks sideways
and catches fish. SAN.

Ceph. July 12, 1957 VII

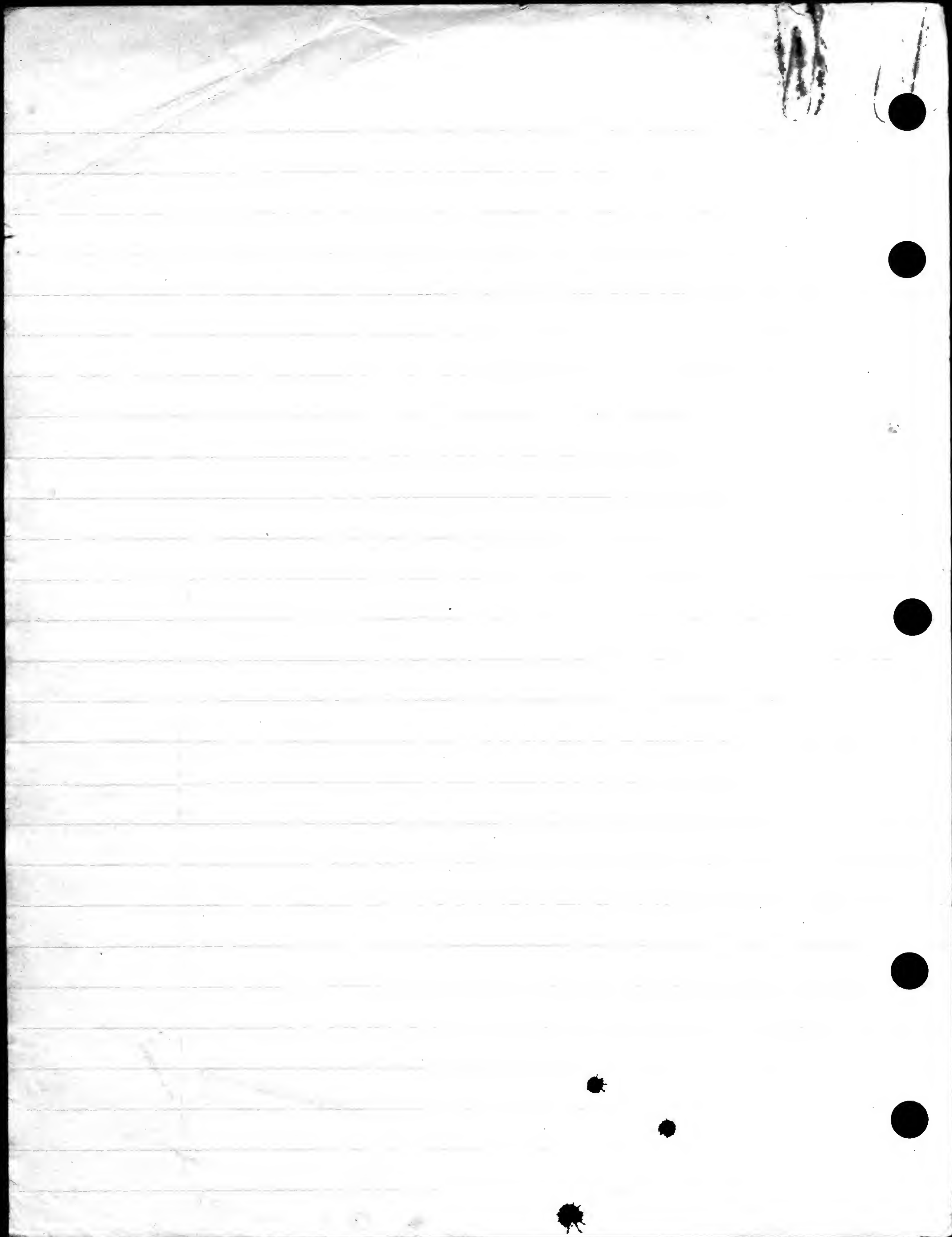
(475)

8:22 3 large S. p. and 1 large D. m. swimming
rather low. S. p. in D. m. D. m. pale. Then pale with a
very faint orange on S. p. side. Not numerous, a mixed school.

A lot of D. m. with 1 S. p. and 1 D. m. A says
the S. p. is a very small one. It is not the
large S. p. in the tank. This group also. Under class it
seems away. S. p.

The D. m. is showing little, but population of the
species still seems to be very good. S. p.

Going to bed 7:10 p.m.



Ceph

May 3, 1978

On May 3, 1978, I took a boat out at night in
approx 10 pm. I dropped the 10' beam trawl except 1 beam
and

May 4, 1978

Midnight. Weather is clear. Light wind. Very hot.
It is dark. I am in my position of about 1/2 mile back and
forth deck side (5-10 mins). Lots of fish. I am sure visible to me.
A boat 8:55. He didn't find any squid either.

We start another tow. A finds group of 14 squids in shallow
TG. They swim out to deeper water. By the time I arrive, they are
1-2 ft up over TG in 10-12 ft water. All squids but somewhat
narrower. There are small. One is almost medium. Group gradually
grows by accretion (2 by 7). At least 20 inds by the end of our obser-
vations. Fin turns in line, sometimes a little scattered. Much of the time
with tentacles semi-extended. Occasionally short advances. At least
one flare. Perhaps actual feeding. If so, prey is very small.

All inds. in Ord + most of the time. Ord + presumably is con-
ventional. WS is wide. PCA is wide. Bottom is light (definite).
Fins are usually colorless. Perhaps with trace of violet in WB? (A
says that he saw some "PH" type mottling on fins, at least sometimes.
But it must have been very faint or slight. Fins usually appeared to
be quite transparent when viewed from the side.)

Ceph. May 7, 1948, II

2
117

There were a few brief retreats from time to time. In each case 2-3 of the wide, assume Quintuple (with Fan stripe) during the retreat itself, but then resume Oct + immediately, as soon as retreat stops. (As far as I could tell, none of these Quintuples was "Quintuple" with Belly stripe. But I can hardly be sure of this.)

A saw one peculiar "asymmetric double" DM performance by one squid investigating sandbars. SAN

There was a group of Spotted Goatfishes with 20 Squids. Association was prolonged and obviously "real" or "specialized". Spotted feeding on bottom, usually 2-4 ft from squids. Probably a wide, approx. on goatfish group. Interestingly enough, the goatfishes were relatively small, not much larger than the squids. A suggests that this correlation of size is typical of the relationship! In the particular association seen this morning, it was difficult to tell who was following whom. I got the distinct impression that the squids were following the goatfishes almost (at least) as frequently as the reverse.

Also SAN for other aspects of relationships between Squids and grazers in general!

Got out of water 9:28 a.m. A does some more towing. Nothing more of interest.

Try again in afternoon. A goes towing around offshore islands (including Jaimupo) toward Pico Heo, 1:00 p.m. Nothing in the way of cephalopods. I get in water 1:20. Out 1:30. A continues tow. Still no cephalopods. A stops 1:45. (A says that there are a lot of big fish around now, including some enormous jacks, Caranx ruber. Perhaps they have eaten or chased away all the squids?)

Ceph: May 7, 1978 II

498

For 2 days at Niatupo. Start work 2:30 pm. We explore all around Niatupo, Little Niatupo (Aitutupo), and a small offshore island (C'et'et'et'et'). I get out 4:15 pm.

NOTE: The water is very clear. There are some very large half crabs around.

A goes to town Niatupo once more.

Running light at night. In 12 ft water, white sand mixed bottom.

7:15 pm. Not quite dark yet. Jack sees 2 large squid go by. When I get there, a few seconds later, there is only one large in sight. Swimming near bottom, in much darker - certainly no WS.

A few minutes later, small shows up at surface. Feeds rapidly on tiny prey. Also makes apparently unsuccessful attempt to strike sardine. In Ord + (conspicuous WS) throughout. No trace of Bar.

Are there "still" daytime patterns?

Rain starts 7:25 pm. We stop observations.

May 8, 1978

Still at Niatupo. Weather is cloudy, rather cold. Start work 7:42 am. A goes for tow. Hunt around Little Niatupo, then over to Big Niatupo.

8:00 am. A sees single large squid. At first in fairly shallow

Ceph. May 8, 1978, II

457

water over mixed sand and coral. Apparently very young. 10-15
in arms. Eggs? Put into the deep water. Then suddenly they
appear when camera is being lowered. Disappear when it is raised.
In Ord +. Retreats over reef on E, still in Ord +, back towards us.
Could E be attempt to "hide"? Then disappears again.

A narrow trail around Big Noddy. Nothing doing.

We stop 8:50 am

Go on to far end of Islander Keys

A starts tow along Parrot type. Over long to end. 10-15 ft. in
and jelly fish in water. But no wind. Then goes over to offshore reef.
Then over to Pine type. Goes along until 200 ft. then I go into
water myself.

11:25 Find group of small separate 60+ inds. (A group at least
45). At first 1-2 1/2 ft up in 10 ft of water over TG. Size of inds. varies.
One or two almost medium. None is very small. (This may be due to
size of the group now.) When first seen, inds. are relatively semi-
scattered. In Ord +. All floating horizontally. Then as we get closer,
they all tend to line up and gradually retreat. Several inds. in Ord +
ple during retreat. Then group splits up. One section apparently goes
into deeper water. The (and other) goes into shallows. Includes 20 inds.

We find the latter subgroup again almost immediately. In 3-4
ft of water, still over TG. Inds "hanging", all in HD, just below surface
of floating debris (leaves, eel grass, etc.) Most of the inds. are in Ord +.
Both WS and PCA conspicuous. A few inds. at one end (near me)
are more yellowish and tend to alternate faint traces of Bar and
Streak (Quadruple?) patterns. These "Yellow" inds have very conspic

Ceph. May 8, 1978, III.

(5)

500

Some Y. do some interesting things in Ord + But most of the other
wds in Ord + some do some interesting things. Then several other wds
begin to follow. Some do some interesting things. It all appears to be rather low
intensity. Around some of the wds. I see the not Quadruple.
Then they group some on. We do not try to follow.

coming out. Yellowish greenish is characteristic of all or most
strake patterns (or at least Quadruple). And it is obvious, now, that
HD is purpurine. Probably, in this species, characteristic of wds floating
beneath debris (or other shelters).

We continue swimming for some time without seeing anything
new of interest. Stop 11:50 am

NOTE: This is "nursery" area where we have seen many young
on previous years. Area where I photographed.

Go out again after lunch. A starts tow around reef side of
Piriatopo 1:15 am. We see ink blobs almost immediately but can't find
individual responsible. Resumes tow 1:45. We find a whole mass of
ink blobs over coral. At least several dozen. Some very large. All
quite cohesive, filamentous. But again we can't find individuals.
A resumes tow again. Continues around Piriatopo, over to Quiriquin-
tupo, to an offshore bank, and then over to Teatupo itself. Without
seeing anything new of interest.

Finally 3:25 pm. We find young in TG flat between Teatupo and
Piriatopo. 12-15 wds. When I get in water, they are 1 ft up in 6 ft of
water. Mostly in Ord +, bodies horizontal or nearly so. Then several
wds do P₂, one does E. Without color change, bodies still more or
less horizontal. Then all the wds. do more extreme P₂ as A approaches.

or perhaps
down

Ceph., May 8, 1978 IV

501

closer to them, floating above them. Perhaps they are about to sink down toward T or at the same time. They enter by split the head more strongly than before. Front end up and back — and some belly patterns. All or a part of the body is broad. They are along sides with low fin-like pattern. The wings are called "Bottom Half of Quadriple". Overd. But a little and the wings also shows Belly stripe ("Bottom Half of Quadriple"). Later, I see another individual with Fin stripes and Belly stripe without Bottom Half of Quadriple. All the birds seem to be in the + above; perhaps the Ord + is rather more typical of the water.

This behavior would appear to be remarkably sophisticated and purposeful. Perhaps a conscious attempt to be cryptic with the environment appropriate to the surroundings? See also below.

The squids and A gradually move on while I am writing my notes. When I catch up, all the squids are in P again, with body tilted as before — possibly because A is still rather above them.

Then the animals gradually move away, backward, moving some distance toward the surface as they do so. I cannot follow the details, as A is photographing again. But they certainly HD as they rise. Then various inds. do Forward V's, Downward V's, and similar patterns. One does extreme split. A should have good shots of all of these.

Then we stop observations for a few minutes. Squids drift off. But we find them again. More or less half way up in water column of 3 ft. All in Ord +. We do not, this time, approach them very closely. Several do P, without color change, and with body more horizontal.

Ceph, May 8, 1978, V.


(17)

502

One ind. shows Sty in Ord + 20 sec. ... to Down-ward P. ... that the body is kept ... Then some ... HD's also ... I notice that the tentacles are semi-elongated ... HD's?? The ... that ... HD are ... HD as ... drift closer.

Then I see several Curls in Ord +. Why? See also below.

One ind. shows brief DM, under ... in Ord +.

One ind. ... goes ... assumes P with extreme body tilt  and shows Bottom Half of Quadruple or (more probably) Quintuple. Then relaxes. Goes horizontal in Ord +.

Comments: Obviously, this whole complex of patterns is very complicated indeed. All of the patterns may be primarily designed to baffle predators. Some are designed to be cryptic (encryptic). Others may be effective because they contribute to aspect diversity. (Of course this is an oversimplification. The same patterns and combinations of patterns may work in different ways in different circumstances.

All the patterns are alarm. Probably or possibly produced by relat-
ively, not necessarily actually, weaker alarm than simple escape with Paling and/or Inking.

① Bars and the various Streak-Stripe patterns may be produced by much the same ranges of internal motivation. Which one(s) of these patterns are produced at any given instant may depend purely (?) upon external circumstances (or what the performing animal perceives or under

Ceph., May 8, 1912. VI.

(8)

503

stands as the external circumstances) Both Bars and the streaks - stripe patterns seem to be designed to be cryptic in relation to inter-specific relations.

② Streaks and stripes seem to be associated with open grounds & E. T.G. They are often associated with the bottom. But its orientation is not always good. They are not always associated by ends. The body is oriented horizontally with the head at the front.

③ Bars are most frequently associated with the bottom in open water, and/or associated with floating debris, especially algae. But there are complications. E.g. A, today, saw 2 animals in the water while sitting on bottom near bar like algae. SAN. Insects such as the last are our best evidence that the assumption of cryptic patterns is under conscious control.

④ HD certainly is cryptic. Presumably usually associated with streaks and stripes (apart from Ord +). Presumably also usually associated with debris above.

⑤ Downward P may be an intention movement of either HD or E.

⑥ Simple Upward P can be an intention movement of a variety of rather different things: Forward movement. Upward Curl. Extreme P.

⑦ Extreme Upward P (body very tilted) probably is the exact equivalent of HD. Also the mirror image. Designed to be cryptic. Usually with streaks or stripes, at least when low toward bottom.

⑧ V's (including split). Cryptic. Often associated with Bars in open water. Also (less frequently?) with streaks and/or stripes in particular circumstances. Orientation of V's probably (also) under

Ceph. May, 8, 1948, VIII.

504

11 *Composita* ?

From day light to night.

It is small medium deposits show up. Nothing very
unusual. But no SAN.

More a single small Dory. About as small as any Dory I have ever seen (quite like small *Sipho* in scale). Swimming at surface. Obviously feeding. On very small prey. Copepods or something similar. More or less dull gray-brown (Cud?). Silver eyebrows (X) conspicuous. Also "stripe" of iridophores down center back. Presumably equivalent of W.S. This stripe is more or less conspicuous according to angle of reflection from light. Rearer subterminal part more often conspicuous than forward part. (This may be what we called "CL" in earlier notes.)

Then group of 3 Dorps, of same size, shows up. Circle under lights. All 3 also is Ord. Several times, group of 3 pines within a few inches of single ind. No visible response by any of the inds.

Are very young Dorps more scattered than older ones? *Lilie Sepiots*? (But note that older Dorps are concentrated at night. Apparently unlike *Lilie Sepiots*.)

Ceph., May 8, 1978 VIII.

(19)

505

Then group of 3 Dorys breaks up, 2-1. A few seconds later, we see 2 Dorys (same, small, size) grappled, face to face or arm crown to arm crown. Looks like copulation, but it must be something else. Center for prey? At the same time, we see that both inds. are generally "Red". Presumably the 2 inds. separate. Swim back and forth, back and forth, side by side, for some minutes. Still in Red. "WS" not conspicuous. "Y" perhaps not conspicuous.

Of course, "Red" as a sign of high intensity alarm and/or invitation is well known in many species of cephalopods. What, if anything, is either the analogue and/or homologous behavior to "Dark"???

Single Dory back again and again. New group of 2 or 3 inds. ca 8:00 - 8:30 p.m. Lots of encounters among them which seem to be hostile. Some inds. in Red, others in Ord (+). These young Dorys would seem to be more (or with) hostile to one another than the young Sepiots. (Or is it simply that these young Dorys are "equivalent" to "larval" Sepiots???)

A sees another "grapple" among Dorys. One ind. in Red, the other rather pale (Ord?). Then sees some swimminger heading back and forth. He thinks that Red inds. tend to be more aggressive than non-Red inds.

Another single presumed Dory shows up ca 8:40. Feeds and lights in usual way. But apparently quite transparent, i.e. all chromatophores contracted. Only eyes and ink sack visible. A catches this animal. Puts it into bucket of seawater. It turns Red.

Logbook May 8, 1978, IX.

(11)
506

... moves when first placed in bucket. Then starts to move around, bumping into side. Then transparent again.

Then we pressure it in bucket.

How many species of *Squilla* are there here?

7:25 pm A single very small (about 1 larval) *Squilla* swims by light. In dark Ord + (1 minute 'S). Disappears immediately.

9:30. Still no second group and lots of small *Squilla* swimming by. What are they doing?

NOTE: At one point this evening, a rather large *Hammerhead* appeared briefly.

May 9, 1978

Start out a *Periptychus*. A lugger tow along reef side 7:54 am. Goes all around island. No squids. But lots of *Paracaudas* of all sizes. Then we go over to *Tiatupo*. Begin tow from point of *Tiatupo* over toward *Paratupo*. I finally go into the water myself 7:03.

We find large group of *Squilla* almost immediately. 1 ft up in 3 ft of water over to flat. Group includes approximately 44 inds. Ranging from quite small to quite large. In diagonal line. Quite finely graded, smallest inds. (about 2 of them) at one end, largest inds. (about 3-4 of them) at the other end. Not many size gaps. Inds. ranging from only 2" to 1' apart.

The smalls and mediums are nearest to me. Most of them are in HD (even this low in the water!) In Ord + (conspicuous WS and PCA, plus Y in many cases). One ind. goes yellow, does extreme P, with

Ceph., May 7, 1948, II

2017

strong body tilt, and Bottom Half of Quadruple to me. (showing lower part of body) is perfect and almost perfectly green.

The longest inds are at the other end of the line. For the 8 from me A is photographing them. I see that they are doing some E's.

Suddenly several of the smaller inds near me go Dark. In P, HD, and horizontal postures. I see that the fins also are some dark, although lighter (or more transparent) than body. No real or well developed B visible.

How low one of the larger inds drifts down to my end of the line. Suddenly does Pie! Extreme. There is no other large nearby. I think that this Pie must have been released by me. Presumably alarm. It was accompanied by slight retreat. Then the animal relaxes. Goes back into Ord +. Drifts back to far end line.

All of the smalls are in more or less typical Ord + now. In some HD, facing me. I notice that V is bright emerald green around edges. The fins are almost transparent, only lightly speckled with brown. At least one row of ocelli is visible on fins, along body.

I also get a chance to look at PCT and arrangement of arms and tentacles quite clearly. Obviously quite variable. But the main dark part is provided by the tentacles. Center (upper?) shorter arms quite light. Also longer (lower?) arms. These latter probably account for the "spade" shape. Tentacles are probably always slightly extended in this context.



Several inds. suddenly go Pale and retreat (backward and hor

Ceph., May 9, 1948. III.

508

ag. 12. 1. 1911

I have been to me when the small animal starts to display
 to me. In this complex pattern. Bottom Half of Quintuple below (I
 note that side limbs continue out along arms). Sometimes yellowish
 semi-PH above. At other times only above. Always with typical (2
 spot) DM above. (As far as I can tell, the DM is not visible from below.)
 The animal alternates 2 postures quite regularly. One is extreme P,
 body very lifted. I think that I shall call this "Head-up", HU". The
 other is horizontal, with arms forward, or even with rear part of the
 body slightly elevated. The first posture shows off the belly pattern.
 The second displays the DM. Everything very well orientated. Design-
 ed to frustrate and/or confuse me (again an element of aspect diversity).
 These little animals are clever!

Then all the birds go very Pale. At least one Indio. And they all
dark off and disappear. 9:28 a.m. Panic apparently provoked by group of
medium sized Canarys Audubon (Bar Jack). These jacks must be import-
ant predators!

Go on to Morpetugo. Start work 12:56 p.m. A tow around Morpetugo itself. Lots of Carranx ruber. Then we go out to the offshore bank. I go into water 2:00 p.m. We are some mile, and swim for some considerable distance. See a lot of sandbars, but we can't find the squids.

Ceph. May 9, 1978. IV

507

themselves. I get out of water and A resumes tow. 2:31 pm. A leads group of ca. 30 small sepiots, but they disappear immediately. After this, A continues tow all along bank, around Siptago sand along reef between Siptago and P. nigrolitops (this is large reef the continues to follow. Without seeing anything more of interest.

COMMENT: The populations of sepiots. This seems to be low now. Presumably it is not coincidental that populations of young *Loligo* (barren, jacks) seem to be high.

Running light at night (at P. nigrolitops)

7:15 pm. Group of approx. 20 Dorys shows up briefly in deep water. Then disappears immediately. Reappears several times more. Always too deep to be seen clearly.

Then 4 small sepiots show up. Not particularly close together. Apparently colorless. Drift off.

Then 2 small Dorys show up. Near surface. In "Ord." Drift off.

Large group reappears from time to time. Always low.

Then 6 small (5 very small) sepiots show up. Quite close together. Also apparently colorless. Conviction; there may be 12-15 inds. in group. In line. Only a few inches apart from one another.

Is this the "post breeding season"? Have we missed courtship and copulation and the major die-off of adults???

Then a single Dory-type shows up. Stays under light. Obviously feeding on small prey. Almost colorless. Yellowish white. No trace of either Ord or Red.

How many species of *Loligo* are there here???

Ceph., May 10, 1978, IV

18

513

Small squid shows up in light on outstart 17:22 gm.

17:13. Single small squid shows up in light and is swimming conspicuously white tentacles. Apparently feeding a tiny fish. At one point shows faint trace of Bar. Then drifts off.

At least this (these) young in light is single.

17:26. Single small squid drifts by several feet below surface. Apparently in Bar.

8:14. Single small squid (age 1 or 2) comes to light in Ord and WS, with DM. Tentacles curl. Then retreats in light with DM. A says that it also does Forward and Downward V's and also begins to Bar on outstart of lighted area.

Back again a few minutes later. In Ord + PH, with 8, DM, and conspicuously white tips to tentacles. Apparently catching small prey quite successfully. Ignoring surface (and the sandies are ignoring it).

Ca. 8:50. A sec. group of 4 small Loligo-types. They leave. Then a medium "Dorys" shows up. In Ord under ordinary light. Then Red-wh under flashlight. They go off.

May 11, 1978

This morning we are going to explore the inner islands near the mainland. The weather is cloudy and windy (at least heavily just after dawn). Water is rough.

Start out as Musatipo. The local people say that there are lots of cephalopods here (octopi and 2 types of squids - almost certainly

Ceph. May 11, 1978, I

514

I got out of the N. N. W. T. and went to a large group of 5 large flocks, but he cannot join them because of disturbance by the other flocks. So he comes to the group around and goes to the middle of the side, then he goes to the middle of the island of Illiganti. Starts to fly for group of birds and in flocks over to flat. They disappear immediately. A time some more birds fly over. Also a large flock of birds. He finds large group of swells in shallow to flat. They also take off immediately. We remain around for a while, then we both continue to go around island.

9:12 am. Above mid. bottom, coral, etc., scattered in sand with some TG. Found 7 large and large-ish Sepiots 1-2 ft up in 10 ft water (but near edge deeper water). Looks very much like some of the places where we have seen courtship at other islands. All the inds retreat several feet. One ind. Pies during retreat. The others are in more or less Ord. 2 or 3 inds show prominent Fin Stripes, briefly, during retreat. Then all the inds line up facing us in a rather pale (and cryptic) version of Ord +. One ind. Pies briefly several times more. One Pie with backward rise. In three cases, the Pies

Ceph. May 11. II

515

look more like anti-predator reactions than like courtship - (cf. see also below)

Then we see a variety of rather interesting things. Thus, for instance, one ind. does BH with DF and appears to have a strong apparent reaction. Apparently releases and goes into C' (+) a few seconds later. 2 inds. went to one with the release. Then a flying Dark all over. Then release, goes into C' (+) and CN and goes. Darks may well have been interested in the light and not the birds were reacting to us, then Dark may be "contagious".)

Then the nearest ind. to me suddenly leaves toward me in Pic! I notice that this individual is the largest in the group. As it turns out (see below), she is obviously ♀. Then she returns and goes back into Ord 4 again.

A few seconds later, she turns Pic again. This time she retreats backward in a typical "backward run". She is followed, closely, also backward by her nearest neighbor, ♂ 1. He is in Ord 4. Both relax momentarily. Then ♀ does another backward run in Pic and she is followed, again backward, by same ♂. This time, he assumes quadruple stroke (definite), briefly, while following.

Then the 2 animals start shooting back and forth, a few yards forward then a few yards back, again and again. (NOTE: This is obviously the same thing as "Rocking". Only in this case there was little or nothing in the way of rines and falls). Most of the time, both ends were in Pastel with Fluttering. Perhaps a rather yellowish version of Pastel I did not notice any B. The ♀ Pied occasionally always, I think, going backward. The ♂ usually accelerated when

Ceph., May 11, 1978, IV,

(21)

516

going forward, getting closer to the ♀. Perhaps also bending. Observed by a female. I saw her do this with the egg. I think that caused the ♀ to go to remove. Young was seen but no any real stimulus or signal alienating it.

Then I noticed that the male was involved with the pair following the female and to the side. As far as I can tell, always on the side of ♂1. (I.E. ♂1 is not to be interposing.) ♂2 usually 1-2 ft away from ♂1. He is usually further away from ♂1 than ♂1 is from the ♀. This spatial arrangement seems to be quite typical. ♂2 is in more or less extreme lateral silver throughout. Silver side toward the pair. (I.E. this is unusual in several respects. The silver is toward the ♀. But presumably only because ♂1 is in between. Obviously ♂1 is the intended recipient. This is good evidence that Lateral Silver is a "purely" ♂-♂ display. It is, I think, ^{unquestionable} however, that the Lateral Silver should be performed by a subordinate or accessory ♂.) The dark side of ♂2 may be either PH (with visible barring) or, or an intermediate. The Lateral Silver is accompanied, all or most of the time, by a slight indication of Z spread on the arms. Comment: this subordinate or accessory ♂ seems to be more aggressive than most. I see, however, that he is definitely smaller than ♂1.

Every once in a while, especially during the backward phases of the back-and-forth "rocking", ♂1 shoots backward particularly vigorously and shears off toward ♂2. Obviously attempts to warn off the latter. Once, one of the ♂s does complete Z spread (Z extending to back) when they come particularly close together. This high intensity Z is, I think, performed by ♂1.

Ceph, May 11, 1978, IV.

517

Family active courtship continues for some time. I notice that both σ^7 's have rather small but very white Pies. What in the world does this signify?

Courtship eventually declines, more or less temporarily. Feeding is fairly good by 9:45 am. σ^7 2 (still) in Yd. PH. σ^7 4 still in Yd. The q still Pies occasionally, even when she is not being approached by a σ^7 . Once she does Pie in apparent response to an approaching A who is photographing!

Once, another (4th's), smaller and, does low-intensity Pie (covering half of body, the rear half) when A approaches her.

I get out of water 9:50 am. A continues photo graphing.

COMMENTS:

Obviously the population (at least of adults) is less stressed here than at the outer islands that we have visited (so far) on this trip.

The Ulgaudi animals certainly are courting. Low intensity. I would suppose that they are just beginning, as the courting pair is still continuing to associate with other companions.

I am still worried about Pie. Obviously the pattern is usually used by q 's to reject "unwelcome" approaches by σ^7 's. But q 's will also do it when not being approached by σ^7 's. Is this "flirtation"? Is it used to excite σ^7 's? To do what? Could it be comparable to the "wailing" of q ducks? Is it ever used as an anti-predator pattern? (I suppose that a reproductively motivated q might become so pent up, with such a lowered threshold, that she might release her "reproductive hostility" upon some non-sexual object.)

ADDITION: There were several goat fishes, of both species, feeding

with one another. The animals are 1-2 ft. up, 2-3 ft. over TG edge of small coral reef. Dorys are all HD and have CL. One has relatively large CL, but it is in a position ventral. (This could be due to its being the ventral side of the other species.) The Dorys are all pale. They all, however, have dark bands on their bodies (and gills). This is either marking of position or camouflage. The Sepiots are a Dory + (conspicuous WS) and are more or less horizontal and/or with slight HD (much less extreme than that of the Dorys) or slight downward pointing of the arms. All animals of both species are facing us.

There are several minor games. All animals retracting a few ft. All retreats backward. All animals with head and arms more or less horizontal during retreat. Dorys do not change color during retreat. Only possibly become even a little paler than before. All the Sepiots, however, go into streaks. In at least one case, the streak is around the whole. (Perhaps Belly stripe only occurs when it can be shown off - i.e. in such patterns as HV and Upward Curl?) This is a good example of a point mentioned earlier. The streaks must be startling rather than cryptic when they are horizontal against a background of ventral TG.

The Dorys are a definite subgroup within the larger group. For a while they are "buddled" all together with Sepiots and other species of them. Then they tend to occur to one side or, more frequently, above all or most of the Sepiots. (This does not, however, necessarily mean that a Dory on the "edge" is closer to its nearest neighbor of the same species than to its nearest neighbor Sepiote.)

Ceph, May 11, 1978, VII

521

This same individual comes back a few min. later & goes off again.

Nothing more. We stop at 5:30 pm.

May 12, 1978

Start at Iliguala this morning. At site where A. just did shells for a nest for a presumed ♀ that looked as if she might be in an egg-laying mood. (Note: this area certainly looks unsuitable for egg laying. It is essentially pure T & flat.) A inspects "nest" 8:10 am. The egg is either "♀" or of eggs. So A starts tow around island.

Only a few minutes later, and a few yds further on, finds group of 52 small Sepiots. All close together, midway in 2 ft of water over T. None is very small; some are almost reaching medium size. Mostly in Ord+. The individual nearest me does HV (not very extreme) with Bottom Quint. Belly toward me, definitely "display". Relaxes. Then goes Yellow with Fin Stripe facing away from me. Showing back? (What is the significance of Fin Stripe???) Then a more elaborate performance, quite reminiscent of one seen a few days ago. Alternates brief periods of HV with Bottom Quint with periods of more or less horizontal or even slightly tail up postures, showing typical (2 spot) DM on rather Yellow with Ord+ back. This ind. stays close to me during this performance while the other members of the group drift several ft. away. I.E. it is effectively a display.

A photographs.

Then, only a few ft or yds away, we find 2 large Sepiots. One

Ceph., May 12, 1978, II

523

with ♀ that A sawing. (My C. also has the "trematic" sound on back)
 really very long. I saw it when I was in a slightly smaller
 than I had seen it before. It was a very long, thin, and
 E. fed. and when I saw it, I saw it. I saw it all the
 "Bottom Bar" (very long, thin, and display) then it starts in
 P. G., with a little DF. Then it starts again with Bottom Bar DF
 continues in E. (could DF be the lowest intensity component of the "V
 complex"? While I was going on, I see that II, 5 ft away, is doing
 extreme HV with Bottom Bar to A. Note that these inds. are almost
 certainly adult. And the Bar and Stroke seem to be virtually equivalent!

A. platensis - blue, purple notes

As far as I can tell, H. W. ands. are not counting.

When I resume observations, I see that I. is in perfect Yellow (really a golden tan), without a trace of the dark marking of typical PH₂ near A. With Y. Without WS (although there is a white scar on middle of back). Little or no P.A. Ocelli on back are conspicuous. There is one row of large (enlarged?) ocelli down each fur. Belly is clear yellowish most of the time. There is no B. Posture is horizontal.

Every once in a while I shows trace of Bottom Bar below. This occurs when A approaches. Then I does several E's to A. Still pure yellow above. Sometimes Yellow, sometimes Banded, below. Once with (2 spot) DM below fin. Belly usually directed facing A, or to one side. In any case, belly pattern is always visible to "pet friend".

Then we get the 2 large inds. between us. I still in Yellow.
Does Curl to me, with Bottom Bar. Then quit floats horizontally,
still Yellow, with DE. Then does a little "rocking" Once does E.

Ceph. May 12, 1978, III

(RE)

Barring remains throughout & becomes stronger, sometimes over bar.
When it is weak, the Bars tend to break up into "fragments". The gen-
eral effect is reminiscent of *Leptocarpus* with *Leptocarpus* & *Leptocarpus*.
Once I shows ordering, DM on back. During the period II, 1 & 2 ft
away, also does a little "rocking". Always in horizontal position, all
ways in Ord & above. Both WS and PA prominent. I don't note
Y. Traces of Bar alternating with not very strong Dark below.

This "pave" absolutely refuses to move. I approached within a few inches of my leg. At one point, I thought that she was going to touch me. Are these animals really territorial? I think so.

The group of swallows is still around. About 5 ft from cages. Apparently slightly segregated at the moment. But see also below.

The langes continue behaving more or less as before. It does several E's, back toward us, Ord + alone. I think (still) Dr. W. is low.

8:44. II has fallen some distance (3 ft.?) behind I now. It is approached, quite closely (2-3") by the largest of the snails. There is no visible reaction between the 2 inds. Both in Ord+. Then II does several more E's, back to me. Still Ord+. But one momentary "flark" of Bar on back superimposed on Ord+.

I is now some distance from me. But still in Yellow with traces of Bottom Bar. Why? Is she just more aggressive or bolder than the others? If so, again why? Is it just that she is the largest of the group?

None of the squids seems to pay the slightest attention to any of the numerous (grazing?) fish in the immediate vicinity.

We stop observations of this group 8:47 a.m. A resumes tow around island. 9:00 a.m. Area where courtship seen yesterday. Group

Ceph: May 12, 1978, IV.

(29)

524

1 still around. Then A finds a small (Rough) Brown A font. sees them, comes to them, moves to them. It is a small Brown and Z. Several encounter the Brown. They are all stopped. The animals seem to be looking at the small Brown. Brown does E in Dark. Then a whole group submerge in Dark. Then Birds leave for Kips in Dark. Is this strange rather high intensity alarm? Then the animals relax. Resume Owl + etc. Several more E's in both Owl + and Dark. One ind does HV with Bow superimposed upon an Owl + above (I can't see below). Then more HV and E performances in Dark. Then one Curl in Dark. Note: all these performances are more or less directly over A. n. p. p.. They cannot be all equally cryptic in the circumstances!

A has been photographing while I have been making these observations. Now he moves away. The animals seem less disturbed. But courtship does not resume immediately (although spawning arrangements would suggest that the "trio" still exists). It is obvious, I think, that these animals are just beginning reproductive activity.

I get out of water 7:15 a.m. A resumes tow around island. Finds another group of 2 medium. Larger over reef. They don't seem to be doing anything very much so we go on. Then A finds another single large in shallow water over coral. Again not very active.

COMMENT: At least the pop of sepiots here is much larger and denser at the moment than were the pops of the outer islands that we visited on previous days.

We leave Ilgandi and go over to mangrove wet by mainland. A tows 9:36. Nothing! We give up 9:50.

Ceph., May 12, 1978, V

(20)
545

The mangrove wet area 11:35 A.M. Ceph. ...
down quite almost immediately. 2 ft up ...
inds. at both wings. Mostly in Ord+. Not very active ...
around. Find 4 medium-large sepiots 3 ft up, over ...
water. Also in Ord+. One ...
Qued below; Ord+ above. Definitely down ...
A continues tow-around island. Steps 12:40

The Dory and Zolles certainly are not continuous ...
Then we go on to Tubuitupo -- one of the "middle" ...
A starts tow 1:35 p.m., around island and extensive offshore reef ...
finds 6 large sepiots 2-3 ft up in 8 ft water over white sand ...
coral. I go in. The inds. are in Ord+. Retreat to deeper water ...
the inds. go off. (A watches them, see Lateral silvers and, probably, ...
Pies). The 4 inds. in front of me remain ...
retreat again. Go Ord+ (from Dark) during this second retreat ...
Is this further evidence that Ord+ is intermediate between Dark and ...
Pale ??? Then the inds. relax. Go Dark again. Seem to be divided into ...
2 two pairs. One ind. does Lateral silver, facing in opposite direction ...
from its "mate." / 7 Silver on far side, away from "mate," as usual ...
Partner does not respond. Displaying ind., presumably ♂, goes ...
Dark again. Then does Lateral silver again. This time 7A. But orient ...
ation of silver side is conventional. Partner remains Dark throughout ...
A photographs

All this seems very preliminary!

I get out of water 2:25 p.m. A resumes tow. A few minutes ...
later, he sees 8 young 10 ft down in 15 ft. of water over coral. 2:47,

Exp. May 12, 1948, VI.

(31)

526

still going along reef. We find 2 larvae, 10 ft apart. Apparently not interesting. Go on continue 3:04 see large white blob in deep water. Can't find animals. Stop observations 3:05 p.m.

Go on to Tepito, another in the island. A starts tow around island and reef 4:02. Nothing significant.

Running light at night at Tepito (near San Blas Point) 7:10 p.m. Large and long type shows up. In south of Gale Ord. Under keel, in some of same area.

NOTE: (L) (D) plus, or at least young individuals of the species, are not "affine" types. Perhaps as lateral as Sepiet-entus ??? But, for some reason do the adults hang out in the daytime?

Small long type disappears after about 5 mins.

8:46 Three larger long types show up. Red-dish. Then go away again.

May 13, 1948

Going exploring again. Start out at Tepito. A begins tow around Tepito 10:00 a.m. Go all around island. Then over to Kaipita. Out along reef. We go into water 10:55. O sees single small Sepiet in TG flat. It disappears immediately. Get out of water 11:06. A tows over to Tepile and around island. 11:16 A sees single large Sepiet. It goes off into deeper water immediately. We continue. Finally stop 11:45 a.m.

Obviously squid are not common in this area now!

Go on to Soledad in the afternoon. A starts tow around island 2:00 p.m. Then out along reef. 2:22 finds group of approximately 32

Ceph., May 13, 1978, III.

527

medium (and) to large flocks. In shallow water 10-15 birds, or 20
 or 16. They move off. Into surrounding water. I don't see the
 group merged. But 2 birds are left. I don't see the
 crowd rise, essentially, and then they fly. I don't see the
 pairs (or flocks). But then whole group of large, medium

We go on a little further, ca. 2:35, and we find a much larger group of squids. Really very large indeed. Low in colt of water - in the Gulf includes over 150 inds! All sizes from really quite small to large. Difficult to see, as water is slightly murky, and the light is poor. As far as I can tell, all or most of the inds. are in C. C., horizontal or with only slight traces of HD or downward pointing of the arms. A small group of little squids near me is quite close. But the others seem to be skittish. Disappear. (The animals around here are shy in general, with exceptions. Why? Too much boat traffic? A lot of harassment?) I get out of water 2:45 p.m.

NOTE: There were a lot of grazers near the very large group of
Seriots. The ones that I see probably are juvenile parrotfishes. Of
either or both parrotfishes: the Princess Parrotfish, Scaevola truncata
emus, and/or the Mottled Parrotfish S. croceus. I did not see any
goatfishes at this place and time. A says that he saw both species of
goatfishes, at least briefly, in the general area. He also saw the parrot-
fishes apparently following the squids when the goatfishes were not
present!!!! (Additional note: A also says that these young parrot-
fishes are difficult to distinguish from Seriots at a distance. They are
in similar groups in similar ways. SAN. Munday? - I doubt it.)
2:00 pm. A turns out and around offshore bank sees a few

Cape May, 12, 1978, VI

528

Small all time. I am going out to sea 2-3 pm.
The tide is out. I am going out to sea 2-3 pm. I will
stop to show up in the boat. I will stop to show up in the boat.
I will stop to show up in the boat. I will stop to show up in the boat.
I will stop to show up in the boat. I will stop to show up in the boat.

May 14, 1978

Just north around San Lucas Point this morning. Start 8:55
am. Cover wide area and great variety of habitats. A lot of We also
saw a lot of squid. Over area where I saw a squid a couple of
miles ago. Then out to area (inside algal reef) where octopus are supposed
to be abundant. A sees one small octopus briefly. Nothing else. No
squid. We stop work 11:00 am.

Back to ship. Ca. 11:30. A few swimming in water near
ship. I see large group of squid, all sizes, perhaps 200 inds!

Perhaps the squids are not so much near as I thought now?
If so, why?

NOTE: It is possible that most of the large squid died a few
weeks or a month ago. Perhaps the distributions and numbers that
we are finding now could be explained on the hypothesis that the old
adults have died while the new, coming, generation is still in the egg
and/or larval stages? ??

And I photograph Halargos squids in afternoon.

Later in the afternoon, we go around Pico Teo. Ca. 4:00-4:30
pm. A sees some ink blobs, but that is all.

Ceph, May 15, 1978, II

(34)
529

Run lights at 11:00 am at night. Lot of small
Also 1 group of small d. p. and 1 group of small d. p. of
inds. in dory group 2-12. Separate group of same order also. Both
Both quite low, difficult to see. Both groups present at 11:00
but apparently not integrated with one another. Also 1 group of
all or most inds. of both species in Ord (4)

Later a single medium sized cephalopod appears at surface in Bay
Feeding on small prey.

May 15, 1978.

Going to try inner islands this morning

A tour around Soledad Mandinga, Tulumayo (Honduras?)
and Arutupo 8:45-9:35. We also do some swimming TG flats and
mice coral reefs. But nothing of interest.

When we get back to ship, anchored off Soledad Mandinga,
we find that 7 small sepia to have been hanging around anchor rope.
Apparently in Ord +. Rather low. Drift off shortly after we arrive.

NOTE: Soledad Mandinga is not the same island visited a
few days ago. That was Media Soledad.

As it happens, this afternoon we go on to vicinity of main
land near Media Soledad. There is a mangrove inlet there,
rather like the inlet near Musatupo but larger and more dis-
persed.

A starts tow around inlet 4:40 pm. Essentially a shallow
TG flat. 4:50 he sees group of sepia. They rise up bolt before

Ceph; May 15, 1978, II.

(35)
530

we can do anything in the water. A few minutes later A sees
(another) B. B. goes down for a while. They (also) later off under
the boat. B. goes down to the bottom. Then and explore along
the bottom until 3:35 p.m. They were quite quiet.

During daylight at night at same (Media foliata) mangrove
ore slit.

7:12 B. goes off to the bottom. B. goes down. B. goes down. B. goes down.
All under the boat. A. goes down. A. goes down. A. goes down.

8:15 B. goes off to the bottom. B. goes down. B. goes down. B. goes down.

May 16, 1978

Quite a lot of heavy rain early this morning. It has been generally
sunny for 3 days now. So the water has become colder than before.

We went out at the (Media foliata) mangrove inlet. A begins tour
8:50 a.m. All around inlet. No thing. We explore shallow banks under
mangrove. Muddy. Full nothing. Stop 9:30.

Over to Media foliata inlet. A starts tour 9:30. Ten minutes later
sees single large sepiot, in mud (deep) water, some considerable distance
away from coral reef. In Basin with "Contracted" arms. Just what
would be expected. Disappears immediately. Stop tour 10:02 a.m.

We go on to Musatipo. A starts tour 10:57. Goes around island.
Then, 11:10, finds group of 5 very small sepiots. One of them looks.
When I get in water, there are 3 near me. One is almost larval.
Half way up in 20 ft of water over sand and TG. At least 1-2 ft apart
from one another. I.E. still too young to be very tightly gregarious.

Ceph., May 16, 1972, II.

(30)

531

They perform both E's and C's (concentric) in Dark and in
"Dark Bar" (note that the animals are



"playful" in the dark of night, in some
very low light conditions.

The animals disappear when I am within 100 yds. We do not find them
again as water is quite murky.

Then we go on to "Elgardo". A town all around island, just as
where I-II, group of snails, and something groups seen a few days ago.
Apparently nothing. Stop 12:05 pm.

COMMENT: The animals are certainly mobile now. But sticking to
particular areas. Perhaps even more so than when they were in the
beginning?

2:05 pm. A starts tow around local mangrove island (where
3-species school seen a few days ago). Nothing seen. Then over to island
to two further mangrove islets, then to offshore bank, then around
Elgardo once more. Still nothing. Stop 3:30 pm.

NOTE: There are quite a lot of birds around here now. Black Terns.
A fair number of Little Egrets and Brown Pelicans.
The occasional Great (Ringed) Kingfisher (always single now as far
as I can tell).

We go on to Morpetupo in late afternoon.

Penlight at night.

6:30 pm. Only a very few small sandlines. Then a single
small squid shows up. Near surface. Feeds on visible prey. In
Ord+. But with tips of tentacles (and arms) conspicuously white. I
shall call this "WT". I am sure that we saw this in other small

Ceph. May 15, 1975

317

532

Sepiots seen just a few minutes ago, but I did not note it
down. Perhaps all we saw (P. DE?) function as a lure?

2:00 saw 2 sepiots swimming up a few minutes later. Apparently
not associated with SAN.

2:22 2 sepiots seen - but not associated with SAN.

7:04 3:00 saw 2 sepiots swimming up a few minutes later. Apparently
not associated with SAN. They are not swimming as a group
like they do in the morning.

A few sepiots seen swimming up a few minutes later (again?).
They move and swim in a group. They are at least 20.
Rather scattered. A few are seen swimming in all directions.
Not a cohesive swimming school. All in Orid. Some with a
trace of "CL" - like pattern (perhaps only trace of bar of iridophores
showing through at certain angles?). Dumps go off.

The sepiots and Dumps certainly are not associating with
one another now.

Probably many of the animals just go down in the water column
when they disappear from our view. But we certainly cannot follow
them there.

7:31. A catches small sepiot. Probably just past larval
stage. We put it in bucket. In Bar with Upward V. Bar is quite
stereotyped. Front bar (front part of body) faint, or even absent
at times. The other 2 bars quite strong. 3rd bar (near) prolonged
by DM (on fin?). The animal swims around energetically. Dumps
several times without changing color (or V). But then V tends
to become more Forward than Upward. Then we suddenly turn

Ceph, May 10, 1978, IV

(38)

533

flashlight on. Animal immediately goes extreme Dark (with typical V or Upward Curl). Plunging back. (Note: we might have expected Bar in these cases. But since the animal was in the "back" to do something else instead in order to be confused or startling.) Then, the animal, with a good look, gets pale, passing through Bar phase, ending up in extreme Pale with typical (2 spot) DM. (NOTE: Dark + is not inevitable during transition from Dark to Pale. Is it inevitable during extreme changes? I doubt it.)

8:15. A very small Sepiet appears. Coming up under light. Very pale in color, with V. Then goes Dark + in shadow of boat. Disappears from view. Then reappears at side of boat. Drifts over 3 small Dorps (deep). No apparent reaction by anyone.

NOTE. A says that inds. of Loligo peruviana will dispute over food (in captivity). Also one will take food dropped by another. Presumably unlike Sepioteuthis (But like Sepia?)

There is no doubt but that large Sepiets are extremely rare in this western portion of the San Blas area.

May 11, 1978

Spent the night at Mergueto.

6:15 a.m. A sees small Sepiet near ship. In Dark +. Does V pattern. Fifteen minutes later, he sees 2 more small Sepiets near ship. See below for details.

Are young just beginning to drift in from open water to nurseries?

Ceph. May 15, 1978, II.

(39)

334

Is this thing of 1978? Or just "normal" every day, every
circumstance?

8:45 am. Just as we are about to depart with the long line, a

big squid comes in.

NOTE: In the morning, to have only 1 squid in the water, the animals are in the water, to see them on the surface.

7:15 am. Just as we are getting ready to start, we notice a group of
19 small squid (small) in the water. They are on the surface, over 20-30 ft. water.
A is already in the water, but I don't go in for fear of frightening the animals.
According to A, they are doing V when he first appeared. They relax
almost immediately. He goes in and out (and in) some of the inds are
quite subdued, just past the larval stage. A photos and approaches them.
They retreat and circle around boat. In Ord + throughout. One ind
does forward V in Ord +. A continues photo-ing. The squid circle around
boat again. This is obviously purposeful. Keeping near "shelter". Then
they all cluster around rope of boat (looped in water) and they all go
Dark as soon as they do so. There is one tiny mottled fish also sticking to
rope. I think it was there before the squids arrived. In any case, the squids
seem to ignore it and concentrate. A continues to advance slowly. The squids
retreat slowly, abandoning rope. Still in Dark, at first, as they retreat.
The mottled fish does not abandon rope, i.e. it does not follow the squids.

Then the squids cluster under the boat. Back in Ord +. Carlos
puts ear in water. According to A, all the squids Ink, without color change,
and shoot away. Come back almost instantaneously. Then do HV in Pale
or Pale-Ord when Carlos moves ear again. Retreat. Back again. I go into
water. All inds. in Pale version of Ord + (ink sack visible and conspicuous).

Exp. May 16, 1972 III

535

COMMENT: I think that Tardus may be just a tendency to be performed by animals taking shelter under a canopy of large objects (including coral).

A start to town toward Moraga, Leguizamo 3200 m. Then over to
Taptupo 8:30. He sees 2 small signs in shadow to left of road and
take off. Then Carlos finds a trap in H. desert. 1000 yds. W. of it
We collect it and take it back to camp 8:50 am.

We put the octopus into chest. It gradually went dark all over. A sign that this is dark. It is dark when it is in the chest several times. Still in chest. It gets lighter. Scales are in corner. In palish mottled pattern, with purple red above. This is "dark" of the species (and/or "general mottle", "acute general mottle" or "conflict mottle" of Packard and Hurlberg)

NOTE: Some Dardis of some type and perhaps some other of kind
s, seem to be higher intensity reflections of greater distance, than all or
most Dardis of type tentacles.

While we are installing the octopus in its new home, Loubser tells me that there have been 2 small flocks at ship and 1 rope. Other groups (12 inds?) behind ship. Feeding on, or at least showing an interest in, very small sandeels. This group may well be partly the same as the group of 4 seen earlier this morning.

9:20 a.m. Single small Septoid shows up near side of ship. In Pond +

Ceph. May 17, 1978 I.

(40)

537

more extreme HV. Then they leave

I go into water. We swim around. Find group of 11 small sepia. They take off a streak (you can't see streak) and around some more. Find more ink. One black & quite small ink.

I get out and A continues to swim. They are swimming around them in fact. COMMENT: the population of small sepia must be very large. Is it getting larger rapidly? (My own observations from 3 days ago).

I go back in water 10:55. We swim around. Get larger group of 11 small sepia near large ink bed. The animals take off a streak. We stop work 11:15 a.m.

COMMENT: Why were there so many ink beds this morning? Are young animals more likely to ink than are older inds.?

Go out to end of Lauder's Cays in afternoon

A begins tow from Tortuga to Puerto 1:30 p.m. Find group of at least 12 small sepia in shallow TG flat 1 ft up to 2 1/2 ft water. Note: water is remarkably warm at this spot now. Retained a small horizontal. Some do Downward Pointing (DP) with extreme PA. All inds. have extreme X. One ind. does extreme HV (almost level) with Ord + (belly pale - i.e. not displaying anything in particular). Then all the inds. disappear. No ink. Why no ink? Because these inds. are less exposed - with so much TG so near - from the inds. of the offshore bank near Mierpeptu? I get out of water and A resumes tow.

2:11 A finds 5+ small sepia. Streaks and TG in shallows over TG. Again they take off. Again without ink.

Cy. b. May 17, 1948, VI

43

538

♀ does another Pie with Backward Rise, in obvious response to approach by ♂1 in Double Strike. A photos. Then a Pie with Backward Rise by ♀ not being approached. (♂1 is just swimming quietly in Ord+, a foot or so away.) NOTE: again Pie can appear to be an "invitation" rather than a repulse. Then the ♀ swims forward in Ord+. ♂1 follows closely in Ord+. ♂2 seems to have lost interest. The whole performance seems to be rather low intensity.

The ♀ and ♂ swim back and forth together. Semi-Rocking

Ceph., May 17, 1978. VII

(17)
537

I notice that ♂ has constant FL. (Is this a "permanent" signal of a sexually mature ♂ ???) Then the ♀ does Lateral Silver. Silver side is toward ♂. Either directed toward him or to some third ind. behind him. Then ♀ goes back into Dred +. Then ♂ does again. ♂ remains in Dred + throughout. As far as I can tell, he doesn't respond to either the Lateral Silver or the last 5c.

Then all the animals disappear. There are more Camarus mud crabs in the neighborhood.

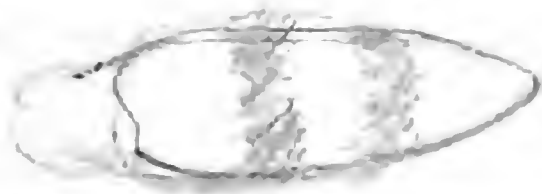
I get out of water ~ 4:15 pm. A minute later, A says that group is back. Now under boat! Behaving as before. So we go on and A resumes tow.

4:07. Reef along point. Find group of 8 large medium signals. Half way up in 8 ft of water. In Dred +, horizontal. Looking so little purplish in dull evening light. Doing nothing at all of interest. Stop work 4:20 pm.

Running light at night. Ship is anchored rather far out, approximately half way between Panetipo and Tialupo. 60 ft of water. Lots of fish show up. Including some quite large "winders". They must be interacting to small squids.

Miscellaneous debris floating by.

7:31. Single Sepiot shows up at surface. Hanging from surface of water at an angle like a piece of debris. In Bar (really only 2 bars above - difficult to tell if any particular "muscular" bar was absent - perhaps the two were fairly centered)



Cyph. May 14, 1772, VIII

540

Adaptation to change!

A sea (presumably) covered in birds a few miles later
still hunting birds. - 1000 ft. Does not hunt for
downy birds, after many without success. Finally
gets prey (small) probably using tentacles this time. SAN.

While up just back again. Still at surface But now in golden Pool. Ocelli conspicuous under light. Catches small sand etc. Not eating articles. Moves Bar as soon as fish is caught. Drifts away with fish in arms. I.E. not swallowing immediately.

Barka few seconds later. Still in Bar. Catches another sandrine. Protudes tentacles slightly before capture. Very conspicuous WT. Then catches fish apparently without using tentacles. Drifts off in Bar.

Rafts back toward light. Apparently clearing last pass.
In Bar with conspicuous conversation of DM.

A says that there are also 6 medium Dory types lower down in water column.

Separate in again. Catches yet another sandvich. Now in 3-bar Bar. Front bar is partial. Top of head also dark. I.E. essentially 4-bar pattern. (I think that this may be "typical".)

NOTE: Like many other higher order predators, *Sepioteuthis* seem to be able to stuff themselves almost ad lib.

Cephalopods, May 17, 1976, IX

46
541

Sepnot in again. Back with "display" of ...
Then flares again. Then catches still ...

8:00 pm. The Sep not ... 12 ...
mes since it first arrived. A says ...
(2 statues - but the second before eating first prey)

Sepnot finally drifts off with a ...
Then back again. In Bar with ...
into Ord, still with Cud, when A ...
ing to Bar each time when ...

COMMENTS: (1) This animal's being very ...
is indeed. (2) Bar might be usual pattern of all animals at
night. (3) It is difficult to believe that this Bar is really an ...
ation of alarm. (4) The mimicry of Sepnotentris is obviously much
more complicated than the matching of background tone and text
were by Octopus (Packard and Heckling again).

9:25. A says that Sepnot has been back again, grabbed 2
sardines, and left once again.

In again 2 minutes later. In Bar. Does Cud. Lower Cud
Statues. Gets very small sardine. Drifts away. Always in Bar.

Presumably these Bars, Cuds, and E's are designed solely to
mislead prey? The opposite of "luring"?

Sepnot in again. This time comes in backward in Bar. A ...
movement of mimicry or oupsis? Suddenly whips around, shoots for-
ward, catches another small prey.

I suppose that it must have caught 30-40 prey by now.

8:40 pm. More and more debris drifting by. In Bar.

Cepl., May 14, 1978, IX

(47)
342

Litter just seen

8:45 pm

May 18, 1978

Pseudotypus agassizii morning. N. of station coral side point
17:58 saw Nothing. Then along coral side island. Go over area where
courtship seen yesterday. App. nothing new. Then back over same
route again. Still nothing. I.E. the animals seen yesterday have definitely
moved.

Then over to *Gyngantypus* 8:55 We too and swim around isl-
and. Nothing of interest. Stop 1:20 pm

Go onto *Ogypsalis*. A starts to tow along usual route around first
island and see 10:10 Nothing for a long time. 11:04 I go into water,
far end island, strait between first and second islands. Find 33 Sepiots.
All large or large-mediums (I think) Halfway up in 15 ft water over
mixed sand and coral bottom. At least one courting pair. ♀ Pus with
only slight Backward Rise. ♂ immediately does Double, obviously in
response, swimming not far from ♀. But he makes no attempt to
approach her. Both inds. relax. Then there is a brief and mild panic.
12 inds retreat, backward, past me. In semi-Pale Ord+. One ind.
also has Fin Stripe during retreat. Comment: Fin Stripe is not really
an integral component of Strake complex. More of an intra-specific
signal? Then animals disappear. I get out of water 11:20.

A starts to tow around second island. 11:36. We find group of
3 large Sepiots. Obviously high intensity courtship. 2 ♂s do prolonged

Ceph. May 18, 1978, II

543

Z with spread wings of female only. No way from the ...
unusually.

NOTE: It seems it has been some time since ...
the area by ... counting ...
not seem to be the adult (note).

A complete tow around second Oyster ...
more of ... We stop 12. a group

Go back to start but ... 2:10
pm. Around ...
counting seen this morning. ...
I go in water. Swim around for some time.

2:45 pm. Mid-channel. See group of 50+ ...
15 ft of water over sand mixed bottom. Group includes everything from
large to very small (tiny). The inds are in Ord + (comprised of 13, 14
and 17), in more or less horizontal posture. Large inds. at one end of rather
irregular line. The very largest of all is at the rear end. This ind. seems
to be ♀. She Pies briefly. No apparent response, not even nearest neighbor
(presumably ♂). Then I see 2 blobs sink in water. I don't know who
produced these - or when. Suddenly all the inds. retreat in some scale.
(This looks like Partel in the ambient light).

All the inds. back a few seconds later. Still in Ord +, horizontal.
Very inactive. Certainly not feeding.

Then one ind. Pies briefly in center of group. Probably not the same
♀ that Pried earlier.

Then things become a little more active. Several Pies by one ♀.
One of these Pies is a response to, or perhaps precedes, a Pies by adjacent ♂.

Capt. May, 1878, III.

(49)

544

2:30 pm. (See page 543) After 2:30 pm. I saw a few more birds. One was a *Phalaropus lobatus*. With a few others it was the only one of its kind seen after 2:30 pm.

The *Phalaropus lobatus* was seen to be a bird with some red on its head. It was also seen to be a bird with some red on its head.

Then everything goes on as usual. The group as a whole, including the things, continues to be of about the same intensity. The things are not showing any more. The things are away. The things are away. The things are away. But note that the things are all and willing to make a vigorous Panes from the very beginning.

There is at least one spotted Gull flying below the squids.

A is photographing. Suddenly one bird in middle of group does full Pie with extreme Downward Pointing when he approaches closely. This would hardly appear to be a response to the approach. I & E reproduce with a lot of G's - even if they are not yet ready to copulate - can still Pie to any sort of disturbance (not only unfortunate G's of their own species).

I come out of water 2:25 pm. A stops photographing 3:10.

Then we go on to western end of Holanda's Cay. A tours around Esmeralda. Nothing of interest. Then starts to tour along lee shore of Minatopo (Manatopo?). Water very murky. We stop 4:27 pm.

Finally to the very tip of western Holanda's. Anchor ship off (Western) Tiatopo and Mancui (Mao Kay?). Going to run light at night.

A few sandhills show up early as usual.

8:05 A large deposit suddenly comes up from the depths.

Cephus May 18, 1978, II

343

Looks very pale and golden. Catches 4-5 sardines in a row.
Certainly not pausing to feed between catches. Moves away
Back a minute later. How motions with C. or V. Curl.
V-Curl. Catches more sardines.

Sepioteuthis does tend to be a solid color. I might!

Same ind. comes in again 8:14. (Bar is present & active. In a
ground. Arms flared and curled. One arm is up. It is up & out
and grasps at prey. Apparently the mouth is open. It is up & out
Back again. In Bar with upward V-Curl. Then catches sardine
with arms. (Remaining tentacle seems to be pulled up & out)

Back again in Bar with E, then with V-Curl. Then it is up & out
ended off by jumping Half-beak.



In again. Bar. Arms flared
Catches another sardine with
arms

NOTE: Bar is usually 3-Bar (one
lady) but "front" bar is incomplete

This ind. comes back again and again. Once captures sardine
in complete Ord+. Then retreats to Bar.

It seems to be almost insatiable. Like ind. seen last night.
Tip of single tentacle certainly is white and conspicuous.
Ginfish panes by. Sepiet Inks and belto. This ink (also)
looks reddish under bright light.

The same Sepiet comes in again and again and again. In Bar,
plain golden (Yellow?), and/or Ord+. Always with E or Curl
or V-Curl beforehand. Are all these arm positions supposed to be

note that dark "centrus" replace WS!

Cefk, May 17, 1978 I

547

across channel to Western Jetty

7.37. Group of 4 small squid. 2 ft. up in water. All 4 do Split. Then one does Forward V. Then one does very well in water is visible. All in the water. 0.5 sec. later. Sticks. At least one will do. A split. Then one does bad Yellow with Split. 2 split. Then one does quickly. To remember.

Finds near small squid only a few. 1.5 sec. later. Just as there, they are approximately 3 ft. up in water and sand. Also in splits. 1.5 sec. later. Then one does A. 2.5 sec. later.

At this stage, I was beginning to think that the squid were in a tradition, but it soon turns out that they are doing coordinated immediate conditions.

C finds the same or another group of small squid almost immediately. 7 inds. 3 ft up in 4 ft of water over sand and TG. When I find them, they are all HD in Ord+. Then one does Downward V, at the Ord+. A photos. The animals retreat. I write notes.

When I look again, a few seconds later, the animals have all gone up to within 1-3 inches of surface of water. A few are there are many TG leaves floating - animal more or less vertical. And the little squid are minicling them perfectly. All in HD. In Yellow version of Ord+. One goes pure Yellow with Fin stripe. Then one red goes into extreme Bar with very Contorted Downward V. All the inds just "hang" with little or no forward or backward movement. Then several more inds show Fin stripe in in Yellow and/or Yellowish vers.

P P P

Ceph. May 12 1978, II.

(53)

548

all of Ord + ... of a ...
... several ...
... for
minutes

The ... is the ... in Bar. It continues in Bar. No trace of alternation or combination with ... It stops the ... Downward V after a while. Wings in HD. Then does Downward V. Then sample HD again. All in Bar. This is second longest ind., second from end (group is roughly ... from smallest to largest). Obviously has a mind of its own. It is much less cryptic than the other inds. (whose resemblance to the ... is remarkable). But it does at least contribute to the aspect diversity of the group.

Now I notice that the tentacles are partly extended in HD. And the tips of the tentacles are completely dark.

All this morning, seems to be very, conservative indeed!

We resume at 8:22. At 8:40, A finds "group" of 4 large Sepiots. Low in 10 ft of water over sand and coral. Actually, there seem to be 2 pairs. Members of same pair usually only a few inches to a few ft. apart from one another. Pairs themselves often 6-12 ft apart. Inds of one pair are slightly larger than those of the other. I shall call the first (larger) "X", and the second (smaller) "Chi".

When I first see the animals, both X's are in dark-Ord+. So is one of the Chi's (the largest of the 2 members of this particular pair, and the nearest to the X's). I shall call this ind. "Chi I". I have no way of

Ceph., May 19, 1972, III

349

knowing if it is ♂ or ♀. On May 20 I suppose that it is a ♂. The other Chri (II) is a rather pale Ind +. Both this does DM with E's. Then both do DM, either to us and for to adjacent Squid. The cypriotes do not seem to frighten the fish. (Come to think of it, have we ever seen anything obviously frightened by DM?) The members of the X pair seem to spend most of their time in slight DM (usually slight P). Usually with quite conspicuous Spade

One ind (as X ???) shows traces of Bar - especially in Dark Ind + when A approaches to plate.

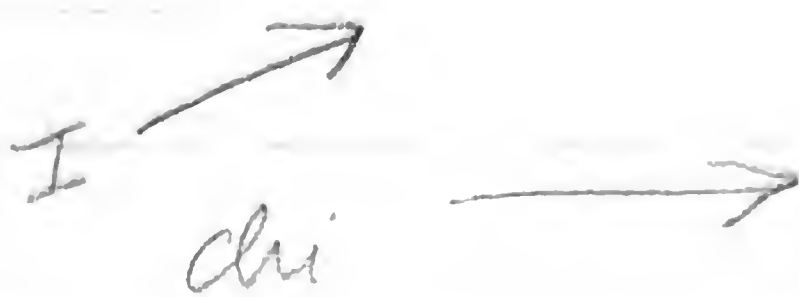
I notice that arms sometimes slightly "up" in E's

One of the Chri retreats from large fish (Acanthurus) in Pale Ind + with conspicuous DM. A few minutes later, Chri I does DM in Dark Ind + with E when another fish of same species passes close by. (There is a large school of Acanthurus in the neighborhood).

There is a single, rather large, Spotted Goatfish like in the squid's

The 2 X's continue "P" P's may become more extreme when Julies swim overhead. But none of the inds. is showing any visible interest in feeding.

Orientation of 2 pairs is usually like this



Ceph., May 19, 1978, IV,

(55)

530

Chi I is in almost constant E. I think that this must be
normal for this species. The X's of Chi I do
not move with the Chi I.

Then the X's begin to move. X's move very gently. Close
together. Still in Dark. One X moves (see PH) with
spade of arms forward (forward fin of Rock) & arms forward,
after him. Accelerates. Goes into some Pool with conspicuous Flutter.

♀ immediately shows partial but conspicuous lateral silver - silver side
toward ♂. This does not discourage the ♂. He catches up with ♀, probab-
ly gets slightly ahead of her, and then "shoots" sideways. Copulation probab-
ly successful. ♀ immediately Flashes, shoots backward in real PH (con-
spicuous dark wording). ♂ also shoots backward behind her.

Then the 2 X's relax. Resume slight Rocking in "P" as before. In
more or less Ond+. They certainly seem to be very well adjusted to one another.

Chi I approaches X's once. X's backs toward it. Chi I retreats.
No color changes by either ind.

X's continue relaxed as before. Several times, the fins of the ♂'s
turn noticeably browner than usual when a fish approaches. Is this low-
intensity indication of Dark? (The ♀'s fins remain light transparent
throughout).

The fins of X's also turn brown when he backs toward Chi I.
Obviously this pattern is hostile.

Chi I is still in almost constant E. But the X's are still
quite calm. QUESTION: the X's would appear to be rather advanced in
their reproductive cycle. If so, why are they (still) associated with Chi I?
Could both Chi I be anemone ♂'s ???

Ceph., May 19, 1976, I.

551

We stop observations of these animals 9:05 am. A continues to move around W. Featupo. Out of water 9:35.

A starts tow. Movement point 11:10. Then A and B start to move along Featupo itself. I go with them. They move away from 11:20. We swim around. Featupo is a small, dark, rocky island. A is 1 ft. of water over mixed coral and sand bottom. Both are in dorsal position with HD. & has remarkably contracted arms. No real V.



Notice of 2 ft. short ventral upper arms

The ♀ stops contract after a minute or so. The ♂ is hanging a few ft. behind her, to one side. He suddenly advances forward in Paillet and flutters. ♀ quit hangs or advances a few inches. ♂ catches up with her. But no cop. attempt. ♀, in more or less horizontal position, does PH or some PH. Definitely with speckled belly. Then both retreat (frightened?) in Pale Paillet. Return a few seconds later. In Ord+. Apparently no longer (for the moment) interested in sex.

General comment: ♂'s are obviously ready to copulate much frequently and earlier than are ♀'s. It is the ♀'s who really control the time and place of sexual activity.

I note that the ♂ has small but "permanent" Rm. Could this be structural rather than behavioral?

Both animals gradually sink down toward dark tubular gorgone

Cont. May 12 1978, VI

5:7

552

Of this sort of progeny, Cy. adults, is theat, who is designed to improve under natural conditions.

The Chris seem to have disappeared completely.

A approaches to photo again. ♀ X turns around. Does DM, then Bar, on Ord +, back toward A. At same time, ♂ E's on Ord +.

(Again) σ does P(HV) - Bottom Quintuple to me. Then he goes horizontal, with DM on Ord + back, and retreats, when A approaches closer. I.E. DM contains relatively more escape than Bottom Quintuple with P (and advance).

Now both ends in HD, Del+. Add DM when we drift above them.

I get out of water 11:55 a.m. A tour to ship without seeing anything more of interest.

When we get back to ship, Luchio tells us that there were 12 small
Seynats at anchor here!

Go on to Matupo after lunch. Toward swim around both is-
lands 1:55-3:10 pm without seeing a single cephalopod or blob of ink.

Copied May 13 1872 III

Anchor boat in channel between the canyon and Pt. Barrow at night. Sandunes show up as usual. Howe & I saw a very large group of small Dorps shows up. Most are 10-15+ units all packed close together. Apparenty all in line



Small Dumps come in again several times. Skid.

Back again 4.50 This time there are some quail in the willow
group. All still in Ord.

Then we stop observations

ADDITIONS: Gail Irvine says that she watched a group of
Squots a few days ago (Monday, 15 May) Mediums plus 2 larges
At Tainupo (off Malumega) From her description, it is obvious
that the 2 larges were engaged in high intensity courtship. She describes
her Pie, Lateral Pelvic (leg & ?), and Small Pelvic.

She also says that she has seen Eupomacentrus partitus attacking (dashing at) sepiots (probably medusae - i.e. larger than the fish. The squids simply moved off.

May 21/12

Explored Porto Bello this morning & did not see
either red shrike or any other bird of the
variety of *hirsuta*. The other birds were
But not a trace of a squid of any kind!

NOTE. Numerous fawns here are well different from those of the
Blas. At least some of the species are different. There are also
common to red Little Blue Herons (as well as yellow and different King
fishers) No Black Terns or Little Egrets (today)

MISCELLANEOUS I have seen something 4-6 ft long & 2-3 ft high
Always apparently alone. All or most with red line to the front of the
snout I may have heard a little once. Very different from the African
species!

August 24, 1972
San Blas

Arrived by air this morning. (Note: A Gascon here since Aug 23). Weather is cloudy but calm.

We start to explore nearby islands. Pomeroy, Vieques, La Puma, a and Sail Rock. Spend all morning and early part of the afternoon. We do not see a single squid. The local people say squid is down (under rocks or in depth). A Thales that this may be true of squid as a whole. But both Ross and Bob White say that they have seen squid around relatively recently. Ross has seen one of the squid.

Ross caught a large squid yesterday. It was quite large. If the population of squid is down, it may be correlated with the fact that the population of fish is up. It will last for the last 2-3 years.

I made a group of approx. 20-25 fish. They looked as if they might be a new species. I saw them on the shore of the island which Carlos called "Calle de la vida". I am fairly certain that he called it "Calle de la vida" up a few years ago.

We go over to the "Calle de la vida" at approx. 5:05 pm. The squid were in the water. They were in 3-4 feet of water over the flat (bottom). The squid are in the water with WS (white) and (black) stripes. The stripes are similar, but slightly on the left side. The stripes show blue and Fin stripes, but no red stripes.

It is my impression that the squid are in the water that all or most parts of Fin stripes are present.

Then the 3th ind. goes (back) into the water. The 3 ind. retreats without color change, and disappears.

We find them again almost immediately. They are in the water and WS, retreating now. Still over TC. They retreat again. No color change. We find them again. Still over TC. There are at least 9 small-

mediums in group. And now they are in Ord with WS, Y, and PCA. Several do Forward V's, without color change, in very rapid succession. Are Forward V's contagious? Are all V's contagious? Is this contagious even typical? In any case, all these Forward V's are slight and brief.

1 (or 2) ind. (s) turn (s) slightly Yellow with a brief retreat. Then the whole group darkens further off. I do not catch the color changes (if any).

A finds group of 5 large spots 20 ft away. Also over TC in water or shallow water. All in Ord with WS. No Y or PCA. Perhaps 1 pair or 1 trio. One ind., presumably ♀, shows brief trace of dark brown "collar" or "collar" — obviously front part of Piel — my fingered upon Ord and WS.

The animals do not seem to be disturbed by our presence. Continue to swim calmly near us. Only very slight and irregular waves of Piel. One presumed ♂ and one presumed ♀ do tend to stick together closely (18" - 2') fairly consistently. The ♀ of this pair is a little Piel (collar) tinge to her Ord. The ♂, on the other hand, has a little more Piel. This is, I think, typical of a pair. (Or not yet a pair?) I saw a pair (again) of silver "Hollers" in Ord (Piel) and WS. (I, II) when ♂ comes particularly close.

Then both extend arms and show more Piel (or WS) and a little (other) color change.

The ♂ twice shows brief Silver. Silver is not very intense. Performance presumably provoked by my presence. Silver is not very intense. WS is distinguishable. But Silver is not very intense. Side toward me is very bright but not intense! Is this a "Silver" display? See also below.

♀ of pair arms still extended, at least to the "arms". The ♂ is not very active or vocal. A ♂ appears to go WT. Then a ♂ appears, not directly toward me. In sort of Upward Pointing. Then a ♂ and a ♂ of arms in light. But tips of longest arms (tentacles?) turned upward. I shall call this "Hook".

I am sure that I have seen this pattern before. Tips of arms (tentacles) in

Hook, certainly white. Perhaps only

becoming hundreds of arms (tentacles?) — which are usually white arms.



way - are exposed ??? (I am fairly certain, however, that some WT per-
formances - without Hooke - do involve a real color change, extending
to the upper surfaces of the arms or tentacles.)

At some point in this process, the tips of the external arms or tenta-
cles are spread apart. A sort of anal-V. But it is also of course the exact
counterpart (and visual replicate) of DF.

And, in fact, the O7 does and DF either just before or just after.
Without any color change as far as I can tell.

Obviously this gave, previously engaged in low intensity courtship,
have suddenly become interested in feeding. Phenomena on very small water-
sides, as I cannot see any, fishes nearby. But in the light of the report
makes an obvious mistake.

I will have to make some additions to the section referring to the
view with the back!

The O7 and 9 of the pair gradually drift to the right - and then
and from me.

Suddenly the small and small stages are seen. All in one place. All in one
all in one, WS, and Y. One or two - with FCA. I note that Y is really
very golden, with a small amount of the edges. Very different from the
Eyebrows. One ind. also has distinct Z or the ind. makes a sound.
(The other ind. certainly do not have these sounds.) The other ind.
also does but partial Z or the ind. makes a sound.

A photo too large. 5:22 pm.
Then we move off. A tries to lead the ind. to the right. The ind. is
of interest.

ADDITION: A was trying to follow the ind. to the right. The ind. is
that the ind. often moves like Z, and that the ind. is Z.

SAN.
We turn lights at sunset. Some to the right. Some to the left. and
was at 4:50 pm. Then I stop for a moment. A tries to lead the ind. to the right.
A also goes for a moment. Again SAN.

28, 12, 1977
San Blas

Still at Okhappukap. Very gray day. No sun.

arms in Ord & WS.

Then both inds. of pair show (more) traces of feeding. Advances upward with DF (at least once) or slight trace V at tip of arms or tentacles (at least once). Definitely no WT. No Hacks. No struts.

Then back to mild courting again.

The ♀ seems to have had trace of Belly Spotting, on each side of body below fins, throughout. I suppose that this pattern must be related in some way to the ♂. Perhaps related to Z? Have I got it right table for the back?

Neither individual shows any trace of Border at any time. Nor have any of the other inds. small, medium to large, courted or non-courting showed yesterday or so far today. Borders do seem to be relatively rare. It is not just that we have been overlooking them.

The pair gradually drift away. A follows them to 7:45. The ♂ and ♀ are still more or less together. Still in Ord & WS. Perhaps the Belly spots have gone. I can't see if - this R2 or not. They are really going over long and elaborate. Still showing about 200-300.

I get out of water 7:45 am. I see a few more. A few more were visible to continue further.

COMMENT: I think that the "Red" pattern is a compound of "Red" and "Pink" may be compound. Composing at least 2 colors. The "Red" and "Pink" and the Dark Flashes.

It is interesting that "Silver", "Gold", and "Red" are all in the same appearance despite their very different effects. This is an other example of the "confusing principle" (i.e. that same pattern can look different while different patterns look similar).

Rain continues all morning.

We finally start out again 12:30 pm. It is raining. We go along Okkoppulung. But along reef. The pair are still in Ord & WS. 12:47. They disappear into water. A small fish is seen. A small fish and 1 smaller Septid edge reef. They also disappear. The pair resumed. A new large number of small fish. But no more. We finally give up 1:55 pm.

Go on to Bo Sidra area

A starts tow along mangrove wet 4:15 pm. Philin too much. Then tow out over offshore shallow. One brief glimpse of a modern Septid over coral. Nothing more. We finally stop 5:45 pm.

accidental?

Then the whole group swims away from us. In Ord + WS (can't see if there is any Y and/or PCA). One of the mediums shows some Fin Stripe as it goes.

We catch up with the 3 larges a few seconds later. (The mediums have gone elsewhere.) The σ_2 is definitely associated with the ϕ and σ_1 , but he still seems to be very unactive. The ϕ and σ_1 do some E in Ord + WS. A advances to photo. The animals retreat again. We find the ϕ and a σ_1 a few seconds later. Presumably this is σ_1 (σ_2 having drifted away).

In fairly shallow water over TG. ϕ is in P with double DM. Back toward us. This becomes 2-Bar (both bars across body). Then 3-Bar (tail end dark).



(The back of the head is also fairly dark, but probably not dark enough to be called "Hood Bar".) I can't

see what pattern (if any) may be on the underside of ϕ . The σ_1 is sideways to us. In normal posture, Ord + WS above, and a bar of Bars (2-Bar?) below.

Both animals relax as A backs off. Then σ_1 retreats a little. Then away. A advances again. Both animals in Ord + WS. The σ_1 is in PCA. In normal postures or "TD" (Tail down) to screen.

I get out of water 8:23.

COMMENTS: These animals are obviously not very big. Yet they certainly seem to be powerful. This may be further evidence that pairing starts early. And that pairs proceed as well as follow parties!

It is interesting that these animals did E in Ord + WS over TG. Why? Because the patterns develop from DM? Is this (for this) evidence that Bars are slightly more "aggressive" (contain slight cumulative escape) than streaks?

A resumes tow 8:22. Finds a large septa 2 ft down edge coral. In Double stroke above. Perhaps also with Fin Stripe. Near gorge. Presumably cryptic. But they go on immediately.

A resumes tow. Finds a more large septa, with net poles, in 20 ft of water over sand and coral. Engaged in coitus. And one copulation! Unfortunately, these animals also display some "can get into water or A can photo."

COMMENT: If this copulation was real, this pair of septa would

seem to be considerably more advanced than the rest of the population.

We go back to boat 7:20 a.m. Start out again 7:50. A tour around Musatupo. 10:01. Find group of 10+ smallish Sepiote in 3 ft of water over TG. In Ord, WS, Y, and PCA. They drift close by me. Some inds. show Z type marks on arms and/or Belly spots at the moment of closest approach to me (I.E. these patterns must be interspecific in this context.) Then the group pranks a few ft. from us. Several inds. do P. Several do "AV" (Arms up). In this latter pattern, the arms are raised as in P, but the body remains more or less horizontal. One ind. does bottom half Quadruple in semi-P. Another ind. does bottom half Quadruple in complete normal posture (no AV) as it switches from facing away to facing toward us.

A photo again. The group goes out into deeper water. A summary to 10:10

Find more Sepiote almost immediately. In fairly shallow water over TG. 18(+?) inds. Ranging from large to medium. They retreat before A. When I get into water the medium inds. are low, almost in TG, will get water. I see a trace of (q?) RL. Then the animals retreat again. Then catch up again. Now all the inds. are in Ord + WS + PCA.

One more retreat and one more catch up. Now we see 3 of the large ones a definite trio. Against end of line. Again 3 ft. away. In semi-Ord +. Swimming back and forth in semi-P. Curious to watch curiosity.

♂, show some small RL.

Now we notice that the Ord of the ♀ has become a definite blue-violet-purpleish. Still with WS. ♂ has become yellowish. Still with WS and with WB.

COMMENT: this ♀ - blue vs ♂ yellow dichotomy probably is typical. Is it evidence of color vision?? In any case, I probably should recognize "Blue" as another distinct ritualized pattern of the species.

A goes in to photo. Animals retreat toward me. ♀, ♂, ♂ all in Ord + WS + Y + PCA now. (Still) swimming back and forth together. At times, during the backward phases (initiated by the ♀?), the ♀ shows several arms on the side toward the ♂. At the same time, the ♂ shows arms show traces of Z marks. This is reminiscent of (♂) lepas fronoides.

One ind. has 2 white scars toward rear of body. Look like "White DM". But certainly not display.

Several inds. (not the adults) do P near me. Tow in water over TC. One shows bottom half of Gunituple in P. Side stripes continued into arms.



The other inds in P are "lane" (unpatterned) below. All inds. are Ord + WS + Y + PCA above. All inds. in P, irrespective of pattern below, are facing me, i.e. "exposing" undersides to me.

I stop 10:30 am. A goes back for another session of photo. Without seeing anything more or interest

COMMENT: I wonder if I should distinguish between "P", AV, and TD in the back? Or at least between AV and TD? Or is the difference purely contextual?

In the afternoon, we go to Morpeltapa. Explore all around island and then along offshore bank. No signs of squid.

Then on to Tia Tapa, where we are less sheltered for offshore for the night

ADDITION: A says that he saw something very strange ^(at Tia Tapa) on his last trip. Groups of Sepiote in water off shore. Ranges from small mediums to larval or almost larval. Stratified. Far apart at top. Smallest further down 30 ft down!?! Quite a lot of inds of smallest. But scattered. SAN

Rain lights at night. Nothing of interest. Only few large types far down in water.

August 30, 1979
St. John

Still anchored off Tia Tapa. Sunny and calm

7:50 am. 2 small Sepiote showing at surface (at least one others further down). At first rather far apart. One almost at surface. Then the 1-2 ft down. Both in Ord + WS. Both unwell (not always with tail extended up, heads facing outward. Then the lower ind comes up, apparently very close to its "companion". At approximately same time, the former turns rather bright yellow, apparently all over. Yellow with little or no WS. (This large color may have been initiated by shaking of anchorage by S. J. - but I rather doubt it.) The former then alternates longer periods of Yellow with shorter periods of Ord + WS. Obviously feeding on tiny prey, diving Yellow-plumes. The other

ind, the "joiner", apparently does not feed. Still in Ord + WS for a few minutes then gradually gets dark(er). Until its WS (also) almost or completely disappears. The contrast in appearance of the 2 animals is very great.

Is this contrast protective? Is it a consequence of the rapprochement of the 2 inds? Is there a general rule involved? The closer together, the greater the contrast? And the greater the unpredictability?

We start out a few minutes later. A begins tow around Tuitupo 8:12. Along near side. Shadow TO flat. We see large Barracuda. It swims off and disappears. A few sec. later. A second like like in water. Then more blobs a few m. further on.

We swim around and find group of 22+ Sepioteuthis. In line. Very well graded by size. Medium to very small (but not any not "large") All facing us. All in Quadrangle (or, in some cases, from Tuitupo) All in P, AV, or TD. Of course with WS. Some, at least, of them seem to have 1. Perhaps also PCA.

There do not seem to be any Fin stripes with these inds. In any "Borders" to fins I notice, in fact, that fins are all in the same. While body at base of fins is very light (This is a feature of the fins and the stroke effect.)

2-3 inds then completely submerge, returning to the surface when they rather suddenly go into more extreme P.

A photos and I look away. Then I drift back again.

Now these squids are submerging, slowly, deep. But a few inds. Surprisingly, a few inds., then more and more, go into extreme P. Ord + as they submerge. (Perhaps because they go completely into "normal" posture, and strokes would not be enough to maintain P.) Fine gradation of size seems to break down among inds. as the animals pause. And gradation is in just the reverse. (This is typical, I think.)

A sees larger Sepioteuthis in distance. Moves to a larger Ind. I stay behind with the group of smaller. Then I look back. Some PCA? Then group seems to get nervous. Begin submerging in a small circle. 2 of the inds. move to brief "bottom Quadrangle" before submerge. Then they go off. Ind. of sight.

I go over to join A and group of larger Sepioteuthis. 10 inds. medium or small langes. Plus 2 very langes. These latter are at end of line - a semi-detached pair. Again group of 10 is further out. All inds. in line, all watch

ing us intently. One in AD (arms down, body horizontal). The rest in Por AV. (Again notice "odd man out" effect) All the mediums in Por AV are Dark below, except for one who has light belly with Bell stripe (another odd man out!). Both the ♂ and ♀ of the pair of very large show Bars (3-Bar) with center stripe (presumably this is related to simple Belly stripe?). Below the Bars of the ♀ are more conspicuous, better developed, than those of the ♂. All of the inds probably are Old + W, or Dark-Crk + WS, above.

All the inds are low in 3 ft of water almost into TG. Dark is not cryptic in these circumstances.

I back away as A goes in to Photo again. Uses flash. No visible response by squids. Not even retreat. The squids are very tame. Perhaps we knew that we drove Paracuda away? In any case, it is obvious that Dark is not alarm pattern. Nor can it, in these circumstances, be an indication of rest or relaxation. The animals are obviously not well at ease.

I am interested to note that we have not, so far, seen any Hymenocera or E's. This may be a further indication that the inds are not particularly frightened of us.

But there - speak of the Devil. A medium off to the right of the mediums does brief E. But it is not significant.

I approach one of the very large (♂?) 1 ft in P. with Bar above - facing me (displaying belly). Then suddenly swims away and returns to "present" side to me. At same time, another very large (♂?) of Quadruplexianus still in P. Light Crk + with conspicuous belly.

This performance must be designed to be before you, as you are the only one who can see it.

I am sure that this animal shows some form of Bar pattern, but rather with Bars or Stripes.

Note: Perhaps I should call "collar" pattern, as it is just a little colored pattern in the back?

We stop observations 8:55 am. Back to boat.

Start out again in 9:00. Explore S. of P. for P. and other groups without seeing a trace of a squid. Stop 9:15.

COMMENT: One of the general observations is that the few groups that we do manage to see are still fairly large. The inds are really gregarious during the daytime, at any given time.

In the afternoon, we go on to Matap. Explore both Matap. Bay and "Little Matap." A fairly group of 4-6 large inds in shallow water over

coral reef, but they disappear immediately. And we can't find anything else.

So we go on to explore large reefs off Pervenir. Bob Warner says that he has seen lots of squids there recently. But again we can't find them.

Atten goes on around Naluneka, starting 4:40 p.m. Finds 5 large squids. Not doing much. Photos

July 1979

Sepioteuthis lessoniana

Guam,
March 1979

Going exploring today

Start out Piti channel, near power plant 11:25 am. Water about 100 ft. sun and cloud. Some wind. This is artificial channel, but not very recent. Sand bottom with some "rubble", coral (not very much) brown weed, quite a lot of *Diadema* on sides. Also many squid are seen here with some frequency. We swim until 12:35. I see 2 small black squid, but that's all. Go on to Luminous reef. Into water 12:40. $2\frac{1}{2}$ ft of sand and coral (*Acropora*). Very pretty but no squid.

Then on to southern part of island where there are grass flats. The local grass is *Eulalia*, not *Thalassia* (*Thalassia* is at Piti from where I'm going). Actually *Eulalia* is a very much like *Thalassia*, but it's much smaller (taller) and more dense. There are some *Thalassia* here and some *Thalassia*. We go into water 2:00 pm. I swim around for a half hour or so. Again no squid.

NOTE: I was somewhat surprised to find that there were no squid here on Pacific coast of Guam. When I asked someone who had been to the coast of Guam about from some region. He said that the squid were young squid a year or so in the past. I saw a few squid. From the history of the area of TG is also known. Going to *Sepioteuthis*.

Guam,
March 1979

Going to try Piti channel again today. Leaving for 1:00 pm. I

Ceph., Mar. 11, 79, I.

go into water 10:10 am.

See groups rather small sandies almost immediately. They are not closely packed (i.e. not being chased or grazed upon at the moment). There also are half beaks at surface. Also quite a lot of goatfish near bottom. Species looks rather like Spotted Goat of Panama, but with one dark blotch at base of tail and a longitudinal dark stripe along side. The first few inds. seen are moving in alone, but later on I see groups of 8-10 inds.

There are no squid with any of these fishes.

Finally, 11:13 am, I find groups of 3 squids. All moving in medium. 3 are quite small. 2 appreciably larger. In line 1-3 ft apart. Furthest ind. nearest to me; largest ind. furthest away. 8-12 ft down in 12-15 ft of water over sand.

They look incredibly like Sepioida.

When I first see them, they are all in "Ord + 1" position. All color on back. Apparently at least some WS. Also PCA and a bit of dark. At least 2 inds have definite extreme V (but this looks very faint in the light).

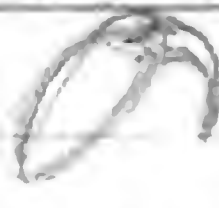
The 2 nearest (and smallest) inds. do E, presumably to me. One of them shows trace of V in E. This same ind. also shows trace of S wave, very briefly, in its E. It is coming and going in this position for a minute or more.

None of the squids seems to pay any attention to mixed group of fishes a few yds away.

I take my eyes off the squids in order to watch the other fish. When I look back, the 3 nearest inds. are all in general back. Little or no WS (definite). Their arms are stretched, elongated, forward to a moderate degree. They retreat (possibly from fear) a few feet.

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One of the inds does E with tail down.  With definite but not very extreme Bell Bar. Then back into ordinary posture with some "flicking". Rapidly but irregularly paling and darkening. Relatively little WS at any time.

The 2 largest inds. have drifted off and disappeared from view 11:25.

The 3 remaining are floating quietly, 2 facing me, 1 facing sideways. All in Dark. (Again or still) no WS. All 3 interest briefly.

Then 1 ind. starts what looks like feeding. On view, small prey, perhaps? Makes several short advances. No real strikes. Back in semi-E. Inds stretched forward. Apparently arms have dark tips.

I get out of water 11:30 when other swimmers arrive.

Go back to same area 1:15 pm. Swim until 2:15 pm without seeing any more traces of squids. Perhaps because the swimmers are still around.

Mar.
March 12, 1979

Exploring new areas today. Going by boat to the south along the west coast. There is considerable rain early in the morning but it stops around 10:30.

11:45 am. Reach Sella Bay. Sky is still overcast but there is no little wind. The water is unusually calm for the area. I am told that squid are often seen here near the reef margin.

Go into the water immediately. Swim over 100' of plain. A great many flocks of many species. Including lots of mummichogs. Bottom deeper and

12:10. Bulbulund sees a large deposit. I swim over immediately. Find that the 2 inds. are engaged in elaborate behavior.

This would appear to be egg-laying.

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Although both inds. are large (more or less comparable to the sepioides of Panama), one is considerably larger than the other (perhaps 10-15%?). And surprisingly enough, the very large ind. seems to be ♂, while the slightly smaller ind. seems to be ♀. (I shall call them "♂" and "♀" without qualification, even though I can't actually prove their sexes.)

When I first see them, the 2 animals are swimming together (6"-1' apart) very near the surface of the water (perhaps 8"-1 1/2') down. Substrate is exceedingly uneven. High coral heads, reaching to within 3'-5' of the surface, interspersed with deep caverns, holes, and ravines which go down to 12'-15' below surface.

What the animals are doing is reportedly visiting a particular site 8'-10' down in a ravine, and then retreating to the surface again between visits. Unfortunately, due to the form of the coral heads, and to the fact that I am caught in a strong current, I cannot see what they are actually doing during their visits. But the ♀ certainly enters or inserts her arms into a hole or crevice. While the ♂ remains hanging in the water near her. Hole is 8' down.

Each time they go down, the ♀ takes the initiative and leads the way. When they come up again, the ♀ also takes the initiative. But she does not usually lead. The ♂ waits, hanging above and behind, while she goes to or into hole. Then he starts up a second after she does. But this means that he is going "before" her.

Most descents are forward. Most ascents are backward.

When the animals are at the surface, they swim quite slowly. Move or less back and forth over a small area (a few square inches). They go close together. Perhaps a form of "resting", but not like sepioides. More uniform than the full Resting of sepioides. Perhaps not a Resting.

At this time (i.e. high in the water), the ♀ is always and the ♂ usually

in a not very remarkable color pattern which resembles Ord (or which is, perhaps a form of Ord). A moderately dark, rather uniform (not conspicuously mottled or spotted) yellowish-brown, at least above. (Belly must be lighter, perhaps colorless). I shall call this color pattern "Yellow Ord" (in contradistinction to "Gray Ord" - see below). Perhaps homologous with some of the "Yellow" or "Yellow-PH" patterns of sepioides (especially as performed by some ♂'s during some courtship).

Yellow Ord may always be accompanied by some slight (thin) trace of WS, but I cannot be sure of this. Certainly whatever WS may exist is usually much less conspicuous than usual WS of sepioides. But the ♂ (at least) may "flash" a much broader and more visible WS (especially on rear half of body) from time to time. This may be a reaction (alarm?) to approaching me.

The ♂ also combines other patterns with Yellow Ord, while in the water. Sometimes Y (again I notice that this is more silvery than yellow). Very often PCA. And PCA is often accompanied by other components: Pale Outer Arms (POA); Bulging; In-and-out waving ("Waving"); and less frequently White-tips ("LWT").

PCA seems to be essentially identical with corresponding pattern of sepioides.

Bulging is a position of the arms. Obviously strictly homologous with Spade of sepioides. But rather different in shape.



rather than

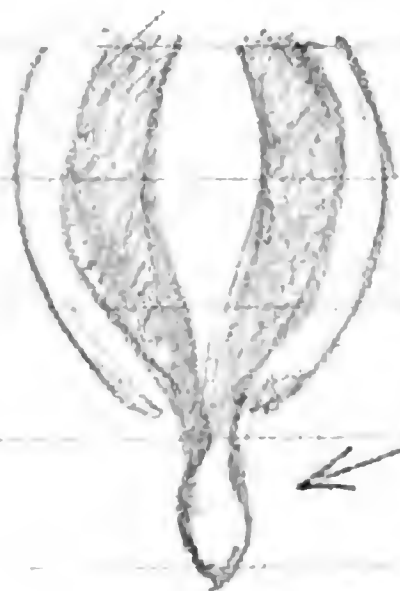


POA occurs with PCA, with both Bulging and Waving. The outside arms are white or nearly so (like PCA). The net result is that the cluster

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of arms appears to be semi-striped. More or less common.

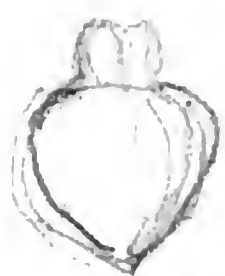


Very diagrammatic!

Facultative LWT

The LWT looks like the WT of sepioides. The tips of some arms (in fact, presumably the tentacles) are slightly protruded and turn brilliantly white at the tip. In the case of this lemoniana ♂, however, I find it difficult to believe that the pattern is a "decoy" or has anything to do with hunting. Rather it seems to be an integral part of the cluster of associated patterns. Probably hostile. See below.

Waving is a more remarkable performance. In this pattern, the 2 outer arms are waved in and out. Usually, or always, synchronous, i.e. together.



This may well be related to the "Winking" of sepioides. But it seems to be more regular or stereotyped, presumably more highly ritualized. It may be the brightest intensity component of the whole PCA, POA, Polyping, LWT series.

The ♀ certainly showed at least a trace of PCA (and of Polyping?) most of the time. Also brief and rare flashes of Y. But she never did Waving. And I don't think that she ever showed LWT.

When the ♀ went down on a visit, she returned with Yellow-Orb (sometimes with minor accessories). Her did she change when coming up from a visit.

The ♂ was much more variable. He sometimes assumed Bar, at least on the back, as he went down. He almost always assumed Bar on the back as

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he came up (only assuming Yellow Ord +) when near the surface Bar on back comprised 3 rather blotchy transverse bars across back (probably without any trace of DM on fins), a dark bar across top of head (usually or always interrupted by Y of eyebrows), one dark bar about a third of the way down the arms, and (usually) a final, interrupted, dark bar about two thirds of the way down the arms (i.e. not far from the tip). So far, this is probably quite like the corresponding pattern of sepioides. But the general effect of the linomama performance seems (to me) to be slightly different. Not only are the bars themselves particularly blotchy (of var. irregular widths), but a faint trace (a smudge) of the 2 longitudinal dark streaks on either side of the "WS" usually or always remains throughout.

I certainly saw some slight (small) RL at various times during this series of actions and reactions. With Yellow Ord, probably by both ♂ and ♀. Possibly also continuing with Bar of ♂.

Unfortunately, from my angle of view, I could not tell if the ♂ had Bar on belly at the same time(s) as on back. I should think probably yes, at least in some cases.

I did, however, look up once from writing my notes, to see the ♂ in a "head up" posture with full and extreme Bar across belly (possibly also dark center streak ???). But unfortunately I couldn't see the back at the same time.

Another time, the ♂ ascended after visit with ♂ as well as back Bar.

On still another occasion, he flashed WS, in Yellow Ord, with retreat after an ascension. This "flashing" may well be an alarm signal.

Which brings up a general problem. What is the world over the point of all this display by ♂ ??? He did not seem to be trying to influence the ♀ directly. This did not look like courtship (which would not be expected in

Mar. 12, '79, VI.

(8)

the circumstances anyhow). All I can suggest is that he was trying to frighten or distract me. Perhaps the ♂'s of this species are more useful during the egg-laying process than are the ♂'s of sepioides??

I finally get out of the water 12:45 pm. Shaking with cold.

Before this, between Chuck and myself, we had seen at least 20 nests by the pair to the presumed nesting hole. And they still seemed to be going strong when I left. Perhaps the clutch of this species is comparatively large?

Then we go a little bit farther north, to next point (name unknown, but just south of Jacpi Point). I go into water 1:23 pm. Clear water over enormous mounds of coral, separated by strips and patches of white sand. One of the graduate students see 2 large squids from boat, but I miss them somehow.

But then I see a group of 6 medium Sepiets. Ranging from rather small mediums to rather large mediums. Mildly graded by size in diagonal line. 3 ft down in 10-12 ft of water. Facing me. Moving slowly backward over both coral and sand.

These inds. are in a kind of "Ord." distinctly different from the Yellow Ord of the adult pair seen a few minutes earlier. This version is generally medium dark gray-brown above. Brown is thickly speckled with rather large (oval) white spots. I shall call this pattern "Gray Ord" for the time being. Combined with definite WS. Also conspicuous silver-white line along upper front border of mantle. I shall call this "WML". All the inds. are very pale, perhaps more white than colorless, below. All have at least a trace of PCA. Possibly also (silver) Y. But almost certainly no Bulge.

The ind. nearest to me does brief but conspicuous turnstape during a brief squirt in its retreat. Very sepioides-like.

I suppose that the Gray Ord of leucianus is more likely to be strictly

Mar. 12, 79, VII.

⑨

homologous with the usual "Ord" or "Ord + " of sepioides than in the Yellow Ord.

Most of the inds. have transparent or semi-transparent (brownish gray) fins with their Gray Ords. But one ind., a relatively large one, keeps its fins more or less white throughout. Unusually more or less milky. But sometimes the fins flash suddenly whiter (or brighter). They may also, conceivably, be fluttered rapidly at the same time. Could this be related to the Partial-Flutter of sepioides a? Could it be an alarm pattern, like the "flashes" of the WS??

None of the inds. has a distinct border (BB or WB) to its fins at any time.

These inds. drift off, out of sight. I get out of water 1:45 pm.

We go on further north, to a site called Minutz Channel. Much the same environment as at previous site. We swim around until 3:00 pm without seeing any more squid.

NOTES: I have been talking to John Eads, one of the technicians at the lab here. He seems to be quite familiar with the local squids.

S. lewismana seems to be the only inshore squid here.

Presumably separated from Lepidoteuthis by differences in depth preferences.

Eads says that he has seen group of approximately 15 young squids, presumably lewismana near surface in deep water (40 ft.) over smooth bottom at a place called Blue Hole.

It seems very likely that the young of this species do not congregate in nurseries on grass flats here. (Eads has never seen them on the Cocos flat.)

Eads also saw a pair of adults engaged in courtship (and/or copulation) at the mouth of the Pago River near the lab.

COMMENT: This species is very similar to sepioides in many respects. But it probably differs in some aspects of ecology, and in details of its life

social and anti-predator behavior.

Guam,
March 13, 1979

CORRECTION. It turns out that the animals seen to be courting or copulating at the mouth of the Pago River a few days ago were octopus, not squids! Not everyone here seems to be aware of the difference!

Be that as it may, we go to the area in mid-morning. Start to swim 10:30 am. It is sunny and windy.

Near the shore the bottom is sand and "mud", with occasional small patches of grass. There is some murk in the water. (Actually, this may be an area of slightly reduced salinity.)

We reach large coral heads, where the octopus were seen a few days ago, 10:45. Water is clearer here. The bottom probably is 15-20 ft down, but the coral heads come up to 2-3 ft below the surface.

See a single octopus almost immediately. Probably quite large, but mostly hidden in a hole in upper part of a coral head. The exposed parts of the body are yellow brown, corrugated and bumpy, just like the surface of the surrounding, or enclosing, coral. This is very good camouflage indeed.

(Mike Parker, the student with me, who saw the animal a few seconds before me, says that it was red before going cryptic. This may be significant. See below.)

I go on a little bit farther. See another octopus. Quite large (head and body 12" ?). Sort of vulgaris-type, but I'd like to know what the particular species actually is. When first seen the animal is seen sitting fully exposed a-4 ft down on top of yellow-brown coral head 10:53 am.

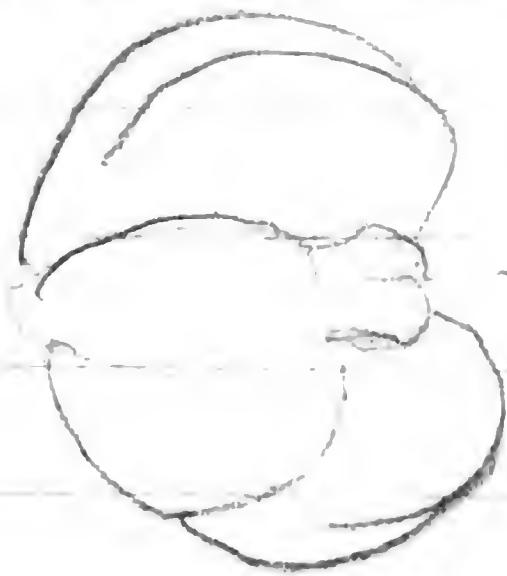
The animal is generally pale cream in color over the whole head and body. Same color extends to, or into, base of arms. Skin is rather like crepe in texture. Most of the arms are slightly darker. Yellowish (perhaps olive-ish) with faint darker transverse bars. More or less tucked around body. The animal also has the "horn" above its eyes erected. Blunt rather than pointed. Ω The pupils of the eyes are very narrow, hardly visible.

After a few seconds, the "horn" disappears, retracted. At the same time, the skin becomes much more uneven. Papillae erected all over body and top of head. I shall call this "tubercular". No color change for the moment.

Then the octopus is attacked by a small blackish pomacentrid. It responds by flashing white. Then resumes previous cream + coloration.

COMMENT: White does seem to be the, or a, high intensity alarm color in all or most coleoid cephalopods. Or, if not white, at least pale or paling.

Then the octopus starts to move slowly. More or less parallel to me. Still cream and tubercular. Arms still tucked around body.



No trace of DM anywhere

Then the animal moves up side of adjacent coral head. Suddenly extends or spreads all arms. At same time goes "Lateral Red". One half of body and head (the right half) goes a rather brilliant maroon red. So do the 4 arms of the same side. The other half remains cream for some seconds. Then also goes maroon. (I shall call this pattern "Full Red".) Arms still extended. And head and body still very tubercular (I think).

Then the interbranchial membranes suddenly flash light or white,

Ceph., Mar. 13, 79, III.

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while the rest of the arms, and the head and body, remain maroon. This is very brief. Then the whole animal turns Full Red again. Definitely (with) Sub-circular at this stage.

Suddenly the animal pours itself down a crack in the coral and disappears from view.

Comes out, higher up on coral head, about 2 mins. later. Now it is yellow brown and lumpy all over. Settles down in saucer like depression at top of yellow brown lumpy coral. Cryptic like the other ind. seen earlier. Head, also yellow brown and lumpy, usually raised to look at me. No Horns.

Suddenly the area is invaded by several other human swimmers. Each time a swimmer comes close, the octopus "sinks down", pulling its head down. But then raises its head again as soon as swimmer moves on. No change in color or texture.

Finally the animal oozes away and disappears as I approach.

I move on, but do not find any more cephalopods. Just a small fish.
12:05 p.m.

COMMENT: Obviously this species, like many other octopuses, can use 2 different anti-predator strategies. It can try to startle a predator or frighten a predator. Or it can try to hide, to disappear from view, in fact or in visual effect. The 2 inds. seen today tried both strategies, one after the other. Is it coincidental that startle or hide it was used before cryptic in both cases? If the sequence is regular, why is it adaptive? Is there a particular element involved? If so, how?

James
Mar 14, 1979

Ceph., Mar. 14, 79, I.

(13)

There is quite a large octopus in tank at the lab here. Possibly the same species seen yesterday. Sitting on bottom. In usual octopus style. But this individual looks particularly inert. Perhaps not at the best health.

Generally light pinkish brown all over. Round or oval white spots on arms. Becoming broader and fainter (to light bars) at very base of arms and on interbranchial web. Head, body, and web also covered by dark red "Reticulation" network.

This seems to be fairly cryptic in the tank.

As far as I can remember, it is also very much like the vulgaris described by Packard.

We go into water in front of lab in afternoon 1:40 p.m. Early start. Sepiots have been seen here on several occasions recently.

Swim over quite a wide expanse of coral and rock bottom. Unfortunately there is a fairly heavy swell, and the water is not particularly clear.

1:45 p.m. Catch very brief glimpse of small Sepia 3 ft up in 10 meter. In some sort of "Ord". Disappears immediately.

We continue swimming until 2:30 p.m. without seeing anything of interest.

NOTE: According to one of the graduate students here, Dennis Pearson, the Sepiots are most common at this site later in the dry season, i.e. (approx. mid-) July.

Colonel Moore also says that some (or diverse) Sepiots at a place called Gun Beach, on west coast of the island, a few days ago. (But this is the time of the year when the squids usually begin to show up.)

All this would suggest that the local Senonomea may well be Senonomea.

Moore has never seen any sort of bottom Senonomea and Sepia calamarius. The segregation between the 2 species must be very great.

P. L. S.
March 14, 1979.

Spent the last 2 days travelling, making arrangements, and also looking at kungfisheries.

Arrive here at Mariculture Station (Malakel Island) at 11:00 a.m.

Almost immediately see large group Sepiots from edge of water to breakwater. Approximately 60 inds. Near surface in 5 ft of water over a little rock and sand bottom. Inds. look medium to large. Formed, facing in all directions, but quite close to one another. Perhaps 2"-6" apart in most cases. All in dark. No

Ceph., Mar. 17, '77, II.

14

WS visible from above the water. Apparently "basking" like sepioteuthis. (Sun is hot and bright. Just enough wind to ruffle surface.) The inds. are very conspicuous against light bottom. But presumably they are deep enough to be out of reach of predatory birds. (Note: the commonest seabird around here is the White Noddy. The next most common is the Brown Noddy. They probably are too small to be dangerous to large Sepiots. But there must also be things like boobies around.)

There also is a school of minnows right at surface. Basking water. Some of the nearest Sepiots may be feeding on these fish. But not making out. No signs of feeding toward them. This is not accompanied by any color changes visible from my point of view.

NOTE: the people here say that squid are abundant around here. I am willing to believe them!

Then I get distracted by stolen Travellers' tree. I walk into water. Start again ca. 2:15 pm. Quite a lot of people around. Swimming in water. Also fishing (poles) from bank. I walk along side, looking for the squids. They are not exactly where they were earlier this morning.

But then I see them (still from bank) some yards further on. Quite a large group (at least 20, but difficult to count). Moving in large birds. Strung out in diagonal line from largest to smallest. Quite close together. All apparently (still) in Dark, at least above.

Enter water 2:30 pm. At a point rather distant from squid. Swim in their direction. Water is slightly murky. Lots of fishes. All of the types, pipefish, etc. Also many large schools of minnows and schools of various sizes. Some dispersed. Others in very tight schools.

Reach area where squid saw earlier 2:40. Several small inds. showing ink in water but the squid seem to have gone. Perhaps because of the darkness.

NOTE: there are large numbers of hermit crabs, Diogenes, and Tide (all sizes) in this area. I.E. the water must be full of them. Also many crabs. Ephorus markures.

2:51 I will catch one brief glimpse of squid in "distance". The same group seen earlier 20+ inds. Halfway up in 8 ft. of water. One sort of "grass". (A plant that I have not seen before. Short, with small, globular leaves.) The color(s) of the animals are difficult to see in the circumstances. I think Dark or dark-bk. The animals also seem to be very shy. Disappear almost instantaneously, gradually going out into deeper water. Without diving. Prudently without diving.

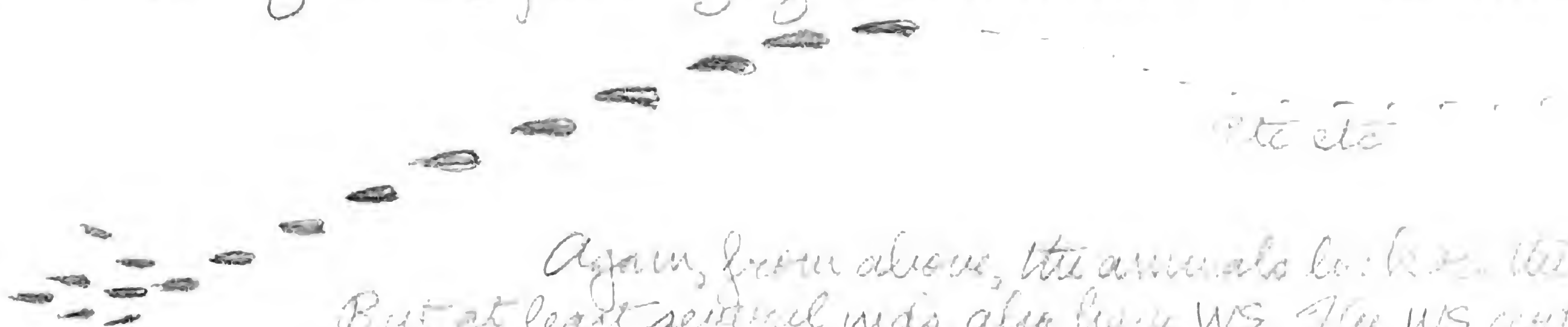
NOTE: a little further out from shore, there are many pieces of coral scattered on sand. This looks like good covering, fast growing, branched.

I swim back and forth along shore. 3:20. Back to area where squid were seen, from breakwater, earlier. Now there are 6-7 very large, apparently new, blobs of ink in water. Something is really scaring these animals. Is it me?

NOTE. the fish don't seem to be at all frightened of me.

Out of water 3:23. Walk up and down shore for a while.

4:00 pm. See squid in "usual" place. Large group of approximately 30 or more individuals. But this not the same group seen in the same place earlier. The animals here now range from medium to small, perhaps very small. Mostly in line, graded by size. Smallest inds in a cluster at end.



Again, from above, the animals look like dark blobs. But at least several inds also have WS. The WS certainly reveals or emphasizes iridocytes in some circumstances. From time to time a WS "flashes" when an animal moves. This looks more like a mirror-like reflection of sun light than like a real expansion of iridocytes.

Go back into water 4:10 pm. Again swim along without being able to find squid. Presumably they have relocated (into a new group). But at least this time without inkling.

The squid here seem to be slayer than the animals at 3:20 as well as the sepioides of Panama.

NOTE. Possibly cephalopods are trapped or fed a little. But they certainly are (also) eaten on Guam.

4:32. Finally see a single squid. Small (but not "small"). This ind. is floating under a school of rather large (larger than the squid itself) "sandlines" 2 ft up in 3 ft of water over sand and coral. The sandlines are rather pale pinkish or sandy in color (paler than bottom "background"). Little or no WS. Retreats and disappears. Faint, shimmering, but not obvious iridocytes catch light as it moves. General effect is golden pink.

This ind. certainly looked like a sepioides at a distance. But I could not see fin shape very clearly. Could there be more than one species of inshore squid here?

Finally get out of water 4:50 pm.

ADDITION and COMMENT. It is interesting and perhaps significant that I have not yet seen any streak patterns by Panama (apart from Fin Stripe and perhaps belly streak with Belly Band). This could be correlated with

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the absence of TG. But *Streakies* obviously could be useful anywhere. There is a common small fish here, perhaps a kind of needle fish (long body and long pointed snout), with a long dark streak on sides of light body, which spends much of its time floating or swimming vertically, head down. Over plants as well as coral, rock, and/or sand. Single or in small groups.

Palau,
Mar. 18, 1979.

Go bird watching in morning

When I pass along breakwater ca 6:00 a.m., I do not see any squid.

On my return at 7:40, however, there is a group of 21 or 22 *Streakies* around. Near surface in approx. 8 ft water (tide is high now). Inds. range from rather small to rather large. When I first see them, they are all in Ord + definite WS, Y (looking really golden now, from this point of view), Spade (not Bull), POA (no POA). Color of Ord looks rather warm brown from here (as the red, yellow, and grey). At this point, the animals look essentially identical to *sepioides*. There is still one possible or probable difference. The "mottling" (light spots) on the flanks of the animals does seem to be more regular, at least more conspicuous, than is usually true of the *Panamaean* form.

The animals are more or less in line, graded by size, but they are not particularly close together. Group seems to be beginning to subside.

Suddenly the smaller inds. retreat, i.e., begin to retreat. Not very fast, and only a few inches. At same time, they lose their WS's. Some may also do darker, briefly. Then they all relax. Float as before. In Ord + but still without WS.

The largest inds. in the group do not retreat. They stay there. They do this throughout.

After some minutes, WS begins to reappear on some or all of the inds.

The association between either dark and/or light and alarm certainly seems to be complicated!

Suddenly, at least 2 of the medium sized inds. both in center group, but not nearest mottleds, show a conspicuous color change. I can't get timing golden all over (arms, head, body, fins). I shall call this "Full Gold". This animal is maintained for several seconds before the purple/greyish returns to Ord + Both inds. do Full Gold several times. But never simultaneously. I can't tell what provokes these performances. Nor do they seem to lead to anything. The other animals seem to ignore them.

Then the whole group swims away fairly rapidly, all animals going backward, without any apparent color change at all! I had no time.

Ceph. Mar 18, 79, II.

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Back to water's edge 7:05 a.m. Water is high now. (Tide here must be appreciable. Much greater than on Caribbean coast of Panama. Or in Guam for that matter.)

Find group of Sepioids immediately. Includes moderately large to moderately small inds. All apparently in "medium" Ord+.

Suddenly one of the larger inds., in line with neighbors on either side, does Latitudinal fiber. Quite extreme. Apparently like sepioides. Goes back to Ord+ then does Latitudinal fiber again. Then back to Ord+ again.

These squids then drift away, out into deeper water, before I go in myself at 7:12.

But then I find what is probably same group almost immediately. 18+ inds. 2-3 ft up in 12-12 ft water over white sand and no red bottom. In a very milky light, sandy (or sandy pink) version of Ord+. Swimming around quite rapidly. Apparently nervous. Disappear.

I swim along breakwater and then back. Lots of fish. Longport very placid. Smaller murex on the other hand, tightly packed.

7:35 a.m. Find new, large group of Sepioids. Including at least 20 in the small inds and 6+ large ones 1-2 ft up over sand and mud. All in milky light sandy coloration. Possibly the same as the "medium" of Ord+ above. But I notice that the "mottling" of the back is much coarser than, more or less "zigzag" dark bars or transverse streaks. Like the dorsal side of some PH's of sepioides. The general effect is different from the usual PH of sepioides (only) because there is different. Not black at all up there.

NOTE: This pattern is quite typical in the circumstances because the water is also milky. Visibility is not particularly good.

These animals swim rapidly under me and then disappear.

I get out of water 7:46 a.m.

COMMENT: The "Ord+" and related patterns of sepioides are not as more variable than those of sepioides in the sense of sepioides for extremes, but they do seem to be more frequent, or continuous, changing.

Territorial arrangements by the breakwater are also extremely complicated. Either the same area is visited by several different groups. Or (perhaps more probably?) all the various schools seen are the same, or the same, new large, "super group"? Or the various groupings are purely exploratory or territorial.

Go out to look (from land) again later in the morning.

11:12 a.m. See new large group. Including 12-15 smalls and many other medium and large inds. The smalls are gathered in a globular cluster. The others stretch out in a line from the cluster. Line at least 25 ft long.

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18

Is this clustering of young typical? (A substitute for T6?)

All the inds. are more or less Dark. At least 1 large has definite WS in Dark. Everyone seems relaxed. Paying no attention to Jellum. Personally basking (sun is bright now).

Go back to water 12:10 pm. Squid apparently gone. Start to swim

12:34. Find group of approximately 10 large Sepiots. 2 ft up in 10 ft of water over sand. Visibility is bad now. But the animals seem to be in something like Ord+. As usual they disappear promptly.

I continue swimming until 12:45 without seeing anything more.

Back to water's edge 3:00 pm. See squid in usual area. At least 10-12 large inds. More or less Dark.

Go into water 3:05. Squid seem to have gone. But then, 3:12, find a group of larges, probably same group seen a few minutes earlier. Now the animals are in milky light sandy coloration again. (I do recall the pattern "MLS".) Some Y. Probably also some PCA, but this is hard, noticeable against the general paleness. The animals pass by me fairly quickly.

I think that MLS must be anti predator Cryptic. It might be a partial substitute for H-bands ???

I continue to swim. Out over coral. See a very large Pannaria type. This may help to explain why the local squid are so scarce.

Out of water 3:35 pm

J. 18
11-403 1979

4:20 am Wading along beach water. Water is very shallow. Group of Sepiots. Near surface 31+ larges, at least 12-13 are visible.

All in more or less dark grayish Ord. With spots. Not too PCA. Some with occasional, slight, transient WS. Perhaps occasional trace of WS. Again notice that white spots on back of Ord are relatively conspicuous.

One large consistently has Y (golden), RL (Edible), and WT (like Sepioida) in Dark-Ord or Dark.

Most of the inds. tend to get darker during next few minutes.

Several different larges go briefly Full Golden. One Full Golden is accompanied by brilliant, broad WS. I can't see what provokes this. Nor does it seem to induce any marked response. Sometimes followed by brief exaggerated Dark all over (for contrast). It is my impression, however, that the Full Golden could well be aggressive, probable threat. Perhaps a reaction to a too-close but non-reward approach by neighbor. It does not seem to be connected with

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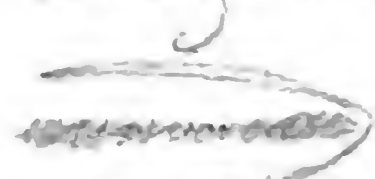
"courtship" SEE BELOW. Not is it, I think, usually (or even?) performed by the inds. involved in courtship.

Whatever it is, this Full Golden, like the "inconstancy" of the WS, would seem to be a distinctive feature of lesoniana.

Several other inds. show only traces of Y in Dark.

Then suddenly one ind. shows distinct Bilateral or Double Silver.

Body turns more or less silver, white on both sides of median dark line. Common.

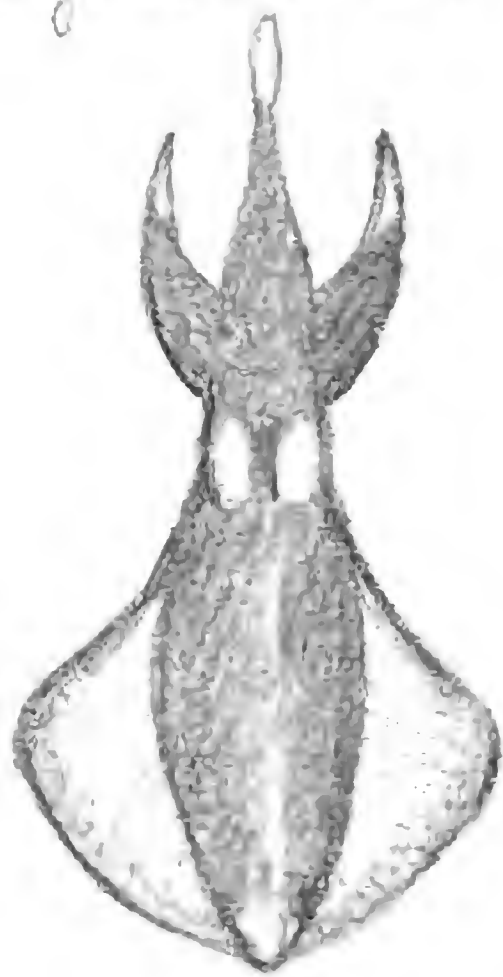
 Fins remain semi-clear. Silver patches are not entirely "pure".
Traces of darker mottling (probably "PH" mottling) remains. Mottling strongest on sides, near fins. D & E silver, white in most colors on either side of median dark or black line. Again, contrast.

See this again several more times. By several inds.

Then I realize that the whole interaction here is very complicated. I am seeing elaborate interactions, of two rather different kinds in two different sub-groups within the larger group. I shall call these sub-groups "A" and "B".

A. This sub-group is centered on the individual in Dark or Dark-Ord with Y, RL, and WT cited above. This particular individual is very large, probably the largest in the whole entire group. Always near center of the group. Remains in Dark or Dark-Ord, with Y, RL, and WT throughout. But now I realize that it is doing other things as well.

It always has a sort of spread. Indent effect. With WT at tip of each of the 3 "prongs".



A variable amount of WS.

Always some light speckling or spotting on dark back. Spotting sometimes appears more.

And it also shows BB. Sometimes very strong. At other times fainter. Quite like the corresponding position of Spiraea appearance.

This animal seems to spend most of its time in a relatively small area. Usually going backward. Movements not usually very fast.

It seems to have picked up 2 associates. These are fairly large, but definitely smaller than the animal ("A Prime") with which they are associating. Definitely a "two". As usual one of the associates sticks closer to A Prime than the other.

This, in itself, is reminiscent of the courtship of Sepioides.

The 2 companions are sometimes in more or less than Dark Ord. More often, they (and especially the closest or dominant associate) show some of the same pat-

ern(s) as A Prime, but in a less extreme form. Generally dark with some WS and light spotting. Some traces of spread, but usually not very wide and with less conspicuous WT. Only small RL. And apparently, as far as I noticed, no BB at all.

The 2 companions follow A Prime. Also usually moving backward. Closest follower usually only inches behind A Prime. Second follower further back, and often to one side.

It was my impression that the same inds. played the "follower roles" throughout. Certainly A Prime was always the same individual.

Even once in a while, A Prime would swim backward at an accelerated rate. Without color change. And without an exaggerated "fluttering" of fins. The closest associate, or both associates, would also accelerate at the same time. Also without conspicuous color change. Sometimes the associate(s) get(s) close to A Prime in the course of the acceleration.

Usually, not much happens. A Prime usually stops acceleration after a few ft. And either gets off at angle, still backward, at slow or less normal un-accelerated speed. Or stops, reverses itself, and goes forward a little at normal or even slow speed. Companion(s) follow, at equally reduced speed. Nothing very similar in the way of color changes at any time.

Once, at the end of an acceleration, the close companion came close to Prime, drew more or less level with it, and then turned over on its back and struck downward, with one or more arms (or tentacles) at general level of A Prime's head or opening of mantle. This looked very like a copulation attempt. But I can not be sure about this. A Prime did not react visibly. The belly of the companion was more or less clear. Fairly light "neutral" in color. It flipped its side up. Mantle and color of upper surface seemed to be just as before.

Another time, some minutes later, when A Prime was going forward after a backward acceleration, a following companion accelerated forward, caught up with A Prime from below and struck upward and forward. I don't think that the companion was ideally placed. Its strike may well have hit A Prime in the belly, rather than at mantle opening or head-arm mass.

In any case, A Prime never showed any movements as if it were arranging a spermatophore.

NOTE: Some of the backward and forward movements of the animals of the A subgroup were slightly reminiscent of the Rocking of Sepioides. But less regular and much less frequently repeated. Prohibited, also without any very great rises and falls.

COMMENT: What was this all about? The whole thing certainly looked sexual, at least in some way. But it also reminded me of some Z-spread encounters of Sepioides. Without, of course, any trace of actual Z?

→ Strikes not very rapid

QUESTION: Does this species lack Z?

B. A sub-group of other colors!

Composed of some 6-10 inds. All large, but not quite as large as A Prime. "Clustered" at one end of the entire large group. I.E. usually 5-10 ft from A sub-group. Usually or always separated from A sub-group by 6 or more other large but placid inds. which were not interacting with either sub-group.

These B animals also seemed to be engaged in "courtship". Approximately half the members of the sub-group played "♀" roles, while the other half played "♂" roles. As far as I know, there was no exchange of roles. But I might easily have missed any exchange if it was rapid and/or inconspicuous.

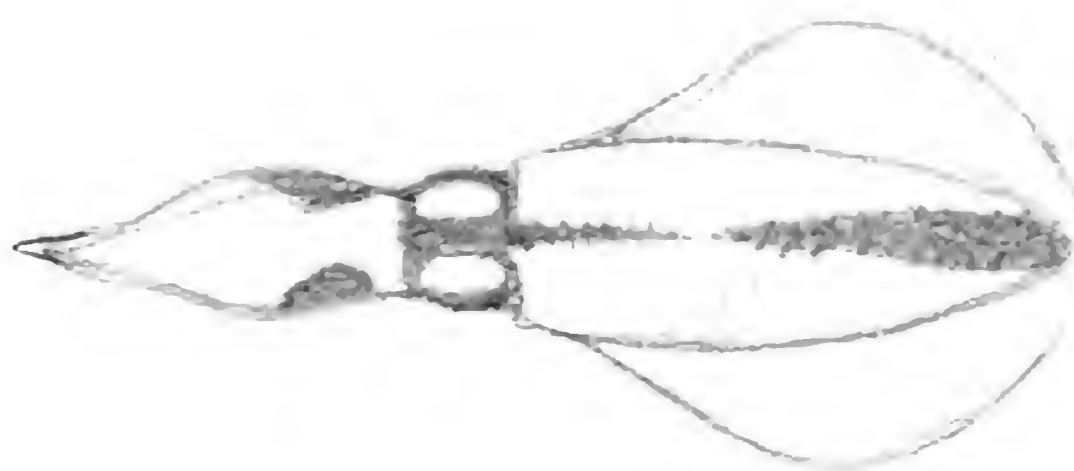
Most of the time the animals were swimming rather placidly, in the color state on that was "normal" for the whole group, i.e. Dark-Red with few or no "accents".

Every once in a while, one ind., a presumed ♂, would make a forward pass at another ind., presumably ♀. It would change color, going from a low tawny yellow all over, with at least some trace of (yellowish) W's, probably X, and at least a trace of faint PH-type darker markings. Then it would swim rapidly forward toward "♀". Usually to one side of "♀". Perhaps also sometimes underwent some indications of Bending during some approaches. And certainly some occasional spreading of arms (and tentacles?) More general and/or irregular than usually Trident-shaped. Perhaps like "withdrawing" of approach? Apparently no flutter.



This tawny yellow coloration recalls the "Yellow" and "Yellow PH" of sepioides. It may also be functionally equivalent to Cat. C. Sp. of homologous with the Parul.

The "♀" is always, like I said, responded negatively to approaches of this kind. Also, sometimes either forward or backward. Very occasionally with lateral flexion (light side toward approaching "♂"?). Usually with Bilateral or Double flexion. It is obvious, in fact, that this Bilateral or Double flexion is structurally homologous with the Red of sepioides. I will call it by the same name, for convenience. But I must note that the form is slightly different.



True BL 79

Ceph., Mar. 19, 1979, V.

(22)

Generally very bright silver. "Mottling" on sides. Median streak black. Sometimes interrupted in middle. Faintest toward rear. Top of head dark except for 2 blackish patches (true Bar II) on either side not far from base of arm mass. Quite stereotyped.

The retreats usually are brief and short. "♂"s usually drop back and resume Ord or Dark Ord as soon as a "♀" signals her unwillingness.

I did not see any "♂" ever strike at a "♀". But I did, several times, see "♀"s make fumbling or re-arranging type movements with arms as if spermatophores had been placed on their fore heads. (This could also, I suppose, have been some sort of DF-type display.)

Once a "♂" made a pass at a "♀"s. Both "♀"s retreated in fire.

More often only a single "♀" was approached at any one time. But (there also) there were occasional bursts of two "♀"s presumed to be following 1 presumed "♂". 1 "♂" appearing to be dominant over the other.

Once a "♂", after a pass, shot backward, still in tawny yellow, after an approach. Panned slowly other inds. showed single, unextended, DM at back fin on side of nearest neighbor.

COMMENT: All this is very difficult to interpret. Both A and B subgroups looked like they were engaged in "courtship". But their "courtship" took very different forms (at the same times, and within a few ft. of one another). Why? Did I completely miss the point? Or were the A's and B's at different stages of the reproductive cycle? (Perhaps the A's were just beginning courtship, while the "♀" B's had already received their spermatophores some time ago???)

Is it conceivable that there is more than one type (species) of squid in this region????

MISCELLANEOUS OTHER POINTS:

While all this was going on, I saw one large ind. apparently engaged in feeding of very small minnows. Advancing on them in a crouch, with the whole party extended and conspicuous WT. Apparently successful in catching one. Still in Dark but now without WT.

Several times, in the course of this morning's observations, I see the whole group of squids retreat before an oncoming fish. These retreats also brief and short. Once the alarming stimulus was a pipefish. Another time it was an Abudofduf-type. The third time, the stimulus was unseen (but it caused minnows to jump out of water some yds away). In each case, the squids came close together and swam away in a medium-color or semi-luxid "Ord +", with Ws etc. This pattern must be slight alarm. But it looks like "relaxed" or "normal" pattern of sepioides. Have the sepioides been more nervous than we thought? Or is this just a threshold difference between species?

Ceph., Mar. 17, 79, VI.

(23)

It seems to be a general rule that WS's are usually more extensive, wider, toward the rear than toward the front of the back.

COMMENT: It is interesting that the WS and the Pie (black median streak) are almost exact reversals of one another, even though they both seem to include escape components. Only the contrast between dark and light seems to be similar in both.

Stop observations 8:10 a.m.

Back at Sea Wall 2:58 p.m. Tide is very low. Water surface very rippled. See group Sepioteuthis in line, but very far apart from one another. Near bottom.

Muddy in dark-Ordn. Several with conspicuous WS.

Group includes at least 15 Larges, plus a smaller number of mediums.

"Cowitup" seems to have stopped for the moment.

Palau,
March 20, 1979

Going to watch at seawall again this morning. 8:00 a.m. Water is low and smooth.

Find group Sepioteuthis immediately. 14 inds. 2 fairly large. Moving down to fairly small medium. High in water. Over sand bottom. All in the sand. Most with definite WS. Some with 1. Little or no WS or (faint).

Then all retreat out of sight. Apparently under the sand. They go. But they are back again almost immediately.

I suppose that larger group is just the same. Several more Larges appear. 3 big ones. One large. 4 small. A flash of Jawns.

Some of the mediums are making feeding type. Advancing. Catching small crustaceans.

One large retreats backward before another advances. Then retreats and in semi-Pie. Advances in Ord. Then advances. Turn back.

One semi-large advances, without color change. It retreats. catches small prey right in front of a large ind. The latter flashes briefly. But that is all. These flashes or brief spreads presumed to be in the land aggression?

2 Larges swimming together. One 1 is. Then retreats.

Several inds. in semi-Dark without WS move to 30.

2 mediums swimming side by side. One suddenly goes Full Golden, no WS, for a second. Then immediately back to normal. Then retreats into Ord.

Possibly Full Golden is less aggressive than Flare?

There are now 21 inds. in group. 4 Larges at one end of line, a fifth

Ceph., Mar. 20, 79, II

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large at other end; smaller inds. in between.

The "isolated" fifth large seems to have caught small fish. Then advances toward school of fish again. In Ord. with conspicuous WT, WS, and white spots on back. Tentacles semi-extended with conspicuous WT. But it does not shoot. Eventually retreats in same color without WT.

This kind of WT certainly is a feeding pattern.

Another ind. briefly retreats after catching small prey (fish?).

4:00 Sudden, all the animals retreat, backward a few ft. Only go very slightly paler as they do so.

Sudden, one large goes yellowish, indication of Jaws and Full Golden, with conspicuous WS on rear part of body, and 2 other spots DM spots, on either side of body (flashing WS), when a slightly smaller ind. approaches. The latter immediately retreats a few inches. D. H. retreat is effective. The approached animal then resumes Ord.

The whole incident is repeated a few seconds later.

Several more brief retreats with no color change or only slight paling (presumably to "milky" level).

One large swims forward to another. Approaches with WS and definite BB. This BB is different from the one seen on A. Proud yesterday. It is a thin black line. A Jaws-like line is also extending out toward body (as in drawing, made as he does). It is possible that the BB of the animal today also has thin white line just outside black line for a few seconds. A brief WS. But then white disappears almost immediately. The approached animal retreats in same Ord. This latter ends 4:13.

Group still composed of 21 inds. It is distributed in a loose cluster along seawall. Very placed on the whole. The difference from earlier.

One large "flashes" WS when approached. It is Ord. Feeding seems to have stopped for the time being.

4:22. There are now 22 inds. in group.

Whole group retreats back, without color change. (Only 1 ind. (20+ inds.) of pupfishes comes swimming along bottom.)

The 3 smallest inds. with the group (4 inds. quite small. 1 ind. is not "larval") are swimming close together. Suddenly all 3 show Jaws and swim toward back of group a few inches. A brief WS. Also shows brief DM, 2 spots on body. Then resumes Ord.

Then the 3 smalls scatter. One goes on to catch small prey. Tentacles protruded forward. But no WT. Body still yellowish Jaws.

It is very difficult to tell the difference between Jaws and Full Golden. In fact, there is a difference.

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Everything still very dull 7:40. Have the inds which were "courtin'" yesterday gone somewhere else (riffs) to continue (and finish) their courtship. Group is down to 21 inds. again.

NOTE: In dark fins are usually semi-dark while still semi-transparent.

Group is now rather jumbled. And no longer graded by size.

One large approaches school of rather large *Amphipr*, in rather pale, conspicuously spotted *Ord*, with WS and T, tentacles protruding. Retreats in same color. Then advances again. In same color, but this time also with WT and (briefly) White Fins. Then retreats without WT or White Fin.

Squid suddenly gone 7:52 a.m. Of course, while I am writing my notes! Stopping observations 8:00 a.m.

March 20, 1979
J.M.

We couldn't go out yesterday because of heavy winds. But the weather is much better today. We will try southern site on the West coast. They seem to be north.

10:15 a.m. Gun Beach. There is a cable channel here. Corner and Moore did their work on *Sepia latimanus* here in relatively deep water. While in borderals of *Sepioteuthis sepioidea* have been seen (and last week) in shallower water here. The bottom is gently sloping coral. The water is clear today.

We all (4 of us) swim around until 12:30, without seeing a sign of either cuttlefishes or squids!

So we go on to Dos Amantes Point, a little bit further north. 11:05 a.m. The environment looks much the same as at Gun Beach. But we find *Sepioteuthis* immediately.

At least 3 large and 2 medium. All are 1 ft, or less, down in 10 ft of water over coral, 20-30 ft from shore.

The animals are not doing anything very interesting, but they are still surprising. They are somewhat scattered. Usually at least 10-15 ft from one another. Sometimes much more.

They all seem to be jerking. Floating, rising, moving. The sea is diagonal, upward, forward "apparently" with arms and tentacles extended. Then stopping, backing off, pausing. Then resuming jumping etc. etc.

They do not make conspicuous strikes with their arms or tentacles to their approaches. But I think that they are catching very small prey (invisible to me) with their (other) arms. This does not seem to be stuck with very small

larval fishes as well as with small crustaceans

The rising approaches bring the squid very close to the surface. Probably within 1 or 2 inches in many cases. This is the closest that I have ever seen Sepiots (except when being pursued by large predators). These squid apparently do not fear attacks by birds from above. Which is surprising. Particularly in the cliffs of Dos Amantes are breeding sites for both Brown Noddies and White-tailed Tropic birds. And both species of birds are flying around today. (I also see a Brown Booby nearby a few minutes later.)

Panamanian Sepiots certainly seem to be more wary of predator birds. Why? Is it because the Brown Pelican occurs in Panama? There are no pelicans in the SW Pacific.

All the squids here today show essentially the same color pattern all the time. A sort of Ord +.

Basic color of Ord is more or less grayish (brown) on head. With well defined WS. Usually white spots on back also fairly conspicuous. So is WMA. (It is more up particularly well in front view. It often appears to be blue-ish white. (Reflection). There is also PCA. But not, apparently, grade. Belly is quite clear, light (but not glittering white).

Rather surprisingly, there is no T. Not even when I approached very closely (2 ft). Does this mean that the T of leucomela is less pronounced than the corresponding pattern of sepioides? (I also see the A. Brown squid here. Watched a few days ago.)

The Ord + also includes other components. Several bands are conspicuous in side view. There is a dark "bar" on side of head, behind eye. This is close to with both the light color of the eye and with the WMA immediately behind. There is also a peculiar bluish-purple, semi-iridescent, "bloom" along side of head, especially toward the front. This bloom seems to extend onto at least some of fins. This bloom is fairly quite conspicuous in this light. I don't think it is particularly purple or not. (It may well have been more prominent when I observed on other occasions. I must have overlooked it when observations were less favorable.)

At least 2 of the larger showed them sharp BB's on their fins when I approached them closely. The black lines were said to be absent at an distance so I can't be sure that they were present in all inds. at all times.

Get out of water 11:30 am. Go north further north to channel in San gusoon Power Plant. Again the environment is coral bottom. Lots of medium sized fishes. But no squid. Stop 12:20 pm.

COMMENT: The local people here keep saying that they encounter squids in channels. This probably reflects the concentration of squids as much as the

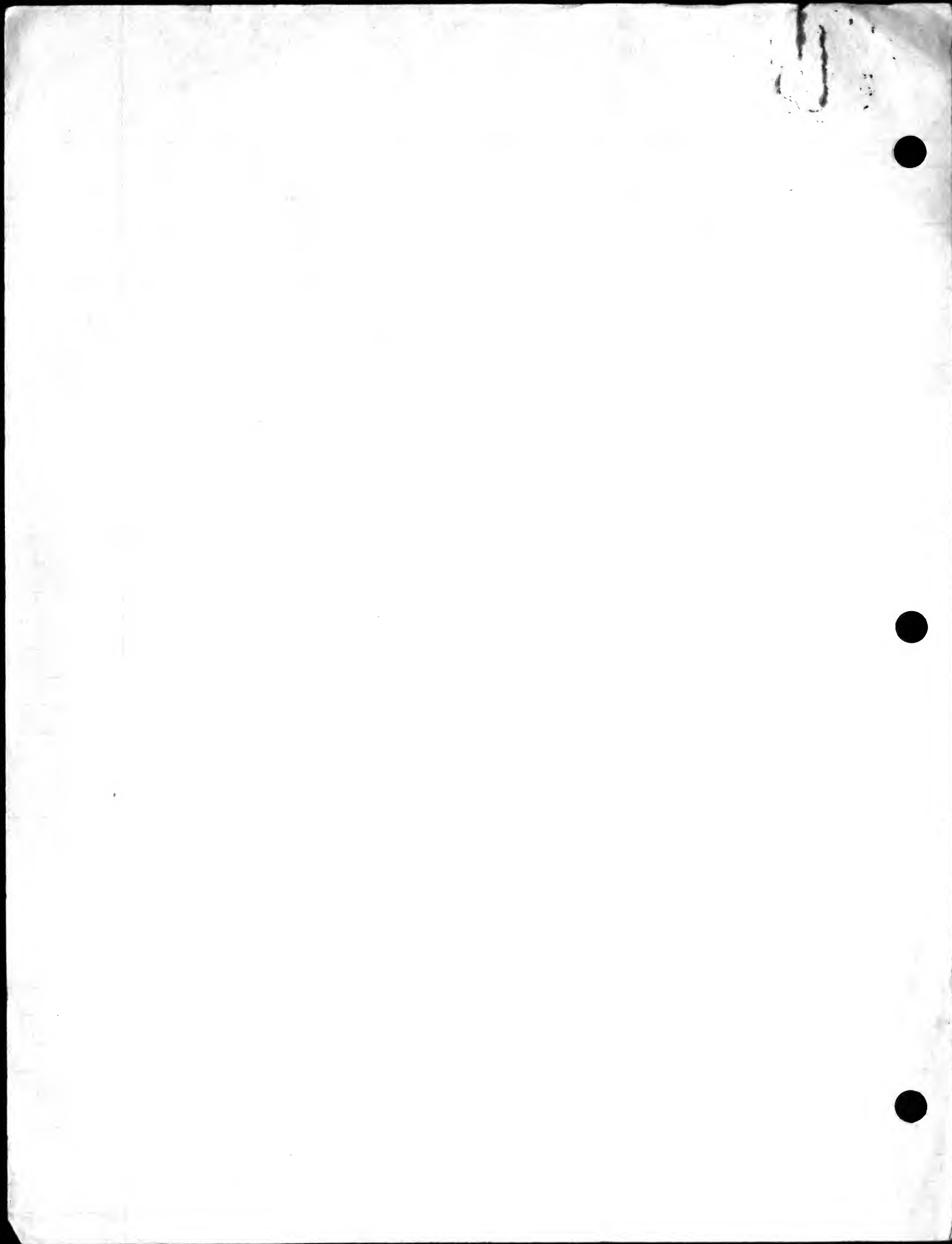
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preference of the squids.

ADDITION: I gave an informal seminar at the lab yesterday. I asked if anyone had ever seen any large concentrations of young Lutjanus anywhere on Guam. The answer is no.

Someone did say, however, that there is lots of Thalassoma on Palau. I wish that I had known it at the time! It might help to explain why Lutjanus are more common on Palau than on Guam. If this is indeed the case



CephalopodaGuam,
June 28, 1981

SEE ARCADIO'S NOTES

Work around Sepungau Beach area 10:50 am - 12:55 pm.

Great variety of environments, sand, coral, etc. Looks like, but only one encounter with squids, 11:23. Obviously Sepietta owstoniana. Presumably Lycoteuthis. Group of 3 inds. To me, they looked like 2 mediums and 1 small. But A, who was closer, says that the largest 2 were actually large by our definition of the term. (A also says that the largest Lycoteuthis are considerably larger than any Sepietta.) The 3 inds. were in mid-water in 8 ft. over coral. All in rather grayish Ord. Pairs Waggoner (common) and PCA. The inds. drift off immediately. Note: Sepietta color changes

Y. M.,
J. M. 11:01.

We did not go into the field today

NOTE. Berkland just came back from Palau a few days ago. He saw large groups of squids by the Marmoulle (Coral). He also saw one cuttlefish. Also in shallow water by the beach water of the C. 15. But none in association with the squids. This ind. was seen on 2 and 3 and 4 and 5 and 6 and 7 and 8 and 9 and 10 and 11 and 12 and 13 and 14 and 15 and 16 and 17 and 18 and 19 and 20 and 21 and 22 and 23 and 24 and 25 and 26 and 27 and 28 and 29 and 30 and 31 and 32 and 33 and 34 and 35 and 36 and 37 and 38 and 39 and 40 and 41 and 42 and 43 and 44 and 45 and 46 and 47 and 48 and 49 and 50 and 51 and 52 and 53 and 54 and 55 and 56 and 57 and 58 and 59 and 60 and 61 and 62 and 63 and 64 and 65 and 66 and 67 and 68 and 69 and 70 and 71 and 72 and 73 and 74 and 75 and 76 and 77 and 78 and 79 and 80 and 81 and 82 and 83 and 84 and 85 and 86 and 87 and 88 and 89 and 90 and 91 and 92 and 93 and 94 and 95 and 96 and 97 and 98 and 99 and 100 and 101 and 102 and 103 and 104 and 105 and 106 and 107 and 108 and 109 and 110 and 111 and 112 and 113 and 114 and 115 and 116 and 117 and 118 and 119 and 120 and 121 and 122 and 123 and 124 and 125 and 126 and 127 and 128 and 129 and 130 and 131 and 132 and 133 and 134 and 135 and 136 and 137 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A resumes tow 9:35 a.m. Back to top and start along outside again. (NOTE: This part of breakwater is relatively new. According to Agge, it was built in 1978. I.E. it is not - at least at this site - on "old" habitat.)

10:10 a.m. A finds large group of Sepiots. Inds range from large to medium. I go into water again.

NOTE: throughout the following long series of complex interactions, I was concentrating on ritualized patterns, color changes, and special movements. It is A who followed interactions and sequences among animals. SAN. My notes are merely supplementary to his account.

When I first see group, the animals are mid-way up a ca. 20 ft of water over boulder bottom. (Again) quite close to breakwater. All inds. in (more or less) Gray Ind with WS and PA. Perhaps made in some cases. They all retreat quite rapidly. Without conspicuous color change. But they do rise very high in water - almost to surface - during retreat.

It is quite obvious that the local Sepiots are not very frightened of predatory birds. (Although) I should mention that there are several Boobies around - in addition to noddies - all type birds.

Then things become complicated and confusing. (at least for me)

I look back from my scrambling to see 2 inds. all in gray. Inds in peculiar maneuvers. At the time, I thought it was feeding. But now I think that the actions are connected with copulation. (I mean by the first copulation cited in A's notes) perhaps connected with sex. Inds do retreat toward the water. Then move back. "Picking" of this species is usually a very rapid retreat. Inds are usually spaced 2 together and 1 slightly apart. (I mean by the first copulation cited in A's notes) Inds advance forward in E+DF in "Partial" color. (I mean by the first copulation cited in A's notes) Inds advance forward from its companions. Inds move forward. "Partial" diagonally forward. Inds retreat. All this looks very much like an attack upon "copioids" or a similar sea slug. Inds retreat. Performs several bouts of "writting". Could it be related to mating spermatophores?

10:23. Inds. apparently relaxed in Gray Ind +. Inds retreat again.

without conspicuous color change.

I notice, close up, that all these Gray Birds have conspicuous fine, irregular white barring.

I think that I also saw occasional White Fins.

A sees another copulation.

The courting individuals - if such they are - are only slightly separated from the other, non-courting, members of the group.

Then the courting inds. become slightly more widely separated from their companions. Perhaps "driven" by us? Now we see that there are really two pairs, slight Rocking. In one pair, first one ind. and then the other turns "lame" or "yellow Bird". The animals of the other pair probably do the same, more or less simultaneously.

Suddenly the members of this last pair move forward. One above the other, 1-2 ft. apart. Lower ind. suddenly accelerates and strikes forward. Apparent copulation!

10:31. All inds. except one have disappeared from my view. The remaining ind., large, is a Gray Bird +. With W.S. The White stripe is conspicuously blotchy. (I should mention that the gray of the Gray Bird of this and other inds. is often very dark toward the rear. On the side of the W.S. The effect is almost DM-like when viewed from the side.)

I find one pair again. In "Gray Bird" + W.S. Gray parts with conspicuous "Purple Bloom".

Then encounter smaller, non-courting, members of group. Strung out in line, but apparently not very far apart. They are all Gray Birds, but apparently not Purple. No W.S. (apparently). One - but not all - ind. has conspicuous WML. Most of the inds. are clear light below. One (not the ind. with WML) is pale above (Gray Bird?) or front part of sides below-fair.

Then whole group retreats.

One ind. - rather large - shows no obvious "Pulse" during retreat. I think that what we have been calling "Pulse" in this species is the strict analogue - even broader - of the "Pulse" of a croaker.

Then all hell breaks loose. A female is laying eggs. She is accomp

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armed by a "covering" or protecting ♂. This pair immediately becomes involved in a furious dispute with one or both members of an adjacent pair. 10. + 3 a.m. Dispute is rapid and violent. Details very difficult to follow.

One or two of the inds. involved in the dispute show extreme spread. Quite as exaggerated as anything by sepioides. But this extreme spread definitely is not accompanied by Z. A different pattern instead. Dark back. Extreme WS. Dark fins. (Perhaps separated from dark of back by light on upper sides?) Arms dark with compressing white, or silver, blotchy borders.



There may also have been lateral silvers (or sides?) or bilateral silvers (?) by one or more inds. at some stages of the dispute. All these "flashes" were brief.

A follows the egg-laying in detail.

In this pair - again - the ♂ is slightly larger than the ♀. Both inds. are in Pastel. Little, faint, yellow or tan mottling. Both inds. also often show what A calls "Midriff Bar". In neither does it run the middle of body. Not often very dark, but usually darker on back than on belly. This pattern obviously is related to the "full" bar pattern of other cephalopods (presumably no. 4 from the front?).

Once Midriff of ♂ develops into 3 Bar on body, there is a change. Perhaps as a reaction to us.

♂ also assumes E's rather frequently. In with "Pastel" and Midriff, I think.

♀ makes repeated descents, at irregular intervals of a few minutes, to presumed nest site. The ♂ remains hovering above which is down. Nest site seems to be in or under boulder. Perhaps 2 ft down in 2 ft water? (Check A) And separately there is a small ♂ P. near by!!!

Both inds. assume 3 or 4 Bar pattern when I drift to. Desc. go back to Midriff when I swim away.

Midriff is often accompanied by Head Bar.

Then I see one full Bar. According to my notes, with 3 Bars. But this must be checked and confirmed.

Ceph., June 30, 1981, V.

(32)

NOTE: When Midriff is particularly dark on back (and light on belly), it looks rather like a dark "dorsal shield". Surely this is reminiscent of some other cephalopods? Cuttlefishes?

The ♂, at least, often has "Y" — again silver — in various patterns and much or most of the time.

11:10. ♂ is doing fewer E's now. But Midriffs and semi-Bastets are still common.

NOTE: There are a great variety, and considerable numbers, of rather large fishes, in this area.

Activity seems to be decreasing 11:07 a.m. And the animals start to drift away and apart from one another.

I get out of water 11:15 a.m. A continues. He is joined by Aggie. The Sepiots come back. A sees a lot of stuff, including more copulations, disputes, and egg-laying.

COMMENTS:

(1) The Bar patterns of this species would appear to be strongly hostile. And they certainly are not cryptic (perhaps not even very disruptive) in this environment.

(2) There is no doubt that Struck patterns are at least rare in this species. Why? Just the absence of Helassia?

(3) The various ritualized components with the Sepiots of Gesonia and are are generally comparable to the corresponding parts of Helassia. But there are numerous differences in detail. And some striking contrasts.

(4) More important, however, is that they are used in different ways. There is evidence — the relatively simple pre-copulatory sequences, and the close protection given to eggs and young by the accompanying ♂'s — that gesonia is an extremely important and sustained among the local gesonia than among the Sepiots of the San Blas. Why? Is predation (presumably from fishes) stronger here than in Panama? Because deep water is so close here?

The fact that the local Sepiots are so often startled here may be another indication of the severity of predation.

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NOTE: The non-breeding animals seen today may have been less skittish than usual because they saw that the breeding adults did not leave the area on our approach.

Guam,
July 1, 1981.

Again going to work along outside face of Glen Brekwater.

A begins tow- from tip 9:22 a.m. I turned wind and sea. But wind seems to be less strong than yesterday.

9:30. A finds group of 20+ Sepiote. Many larvae (perhaps quaking down to medium ???) When I get into the water, I find them in a diagonal line. All in Gray Ord. One ind. seems to have RL (but this could have been a scar). Another ind. shows WT.

Then suddenly one ind. goes "Pantel" with Fin Stipe. It approaches one or more other inds., barks word 3-4 times. The approach ind. (s) retreat (s). Without conspicuous color changes. Approaches each time approached retreats. Does "flame" (arms spread three-dimensionally). At least one flame includes DF.

NOTE: We are seeing all these "Pantels" from the side. We can not determine the appearance of the animals as they might be observed from above. It is conceivable that what I am calling "Pantel" here is related to what I called "Bilateral Silver" in Palau in 1979. But I doubt it.

All the inds. move off 9:36. A resumes tow. A group of 7 Sepiote, presumably large. Inactive and uninteresting. Then group of 13 larvae. All gone before I can see them. NOTE: Population of large Sepiote is dense along the outer face of this breakwater.

Then we tow back and forth along breakwater. Certainly passing and re-passing site of egg-laying yesterday. Nothing today. (This is interesting in itself.) Then A continues tow-in landward direction.

10:50 a.m. A finds group of 30 rather small inds. Close inshore. (NOTE: all animals seen today, including later genotypes - see below, were quite close inshore.)

Ceph., July 1, 1981, III.

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spot on each fin. Common ca.
But they certainly are em-
ing. (This Fin-beating,
some or all of the exaggerated Fin-beating may also be accompanied by some-
thing like WB.



Not equal in size. Perhaps this is
phrased by the exaggerated Fin-beating
incidentally, must be a display in itself.)

The ♂ of the pair also shows occasional Flares and E's with DF
and WT throughout (intention movement of "strubling"?).

The ♀ remains in Gray Ord with WS, WML, and PCA. They are
usually or always dark-ish

Now I see that there are at least 6-7 other inds. (all large?) around.
Pair drifts off. A goes to get camera. Both Ws Ord 2 inds. I
probably is ♂ of pair (has white spots on fins). The other ind. is a young one. Both
inds. are in Ord + \Rightarrow semi-"Pastel". There is a brief but
obvious dispute. I do not see the releasing stimulus. However I am sure who
exactly was involved. In any case, dispute includes a spray by the ind.
Black blotches on arms; but certainly no typical Z. Then both inds. go to
swim off, away from one another, at least at first. In the background, a large
Fin stripe

One ind. (again) does exaggerated Fin-beating with white spots. Several
other inds. approach. They are in Gray Ord + the white-spotted ind. is
closer to them. There may be more "em. taking". But I shall be taking
photos

12.20 pm. Pair in front of A. Now a pair (Gray) Ord (+). One of
the members of the pair, apparently the ♂, goes down to nest site, 2 ft down
in 4 ft of water. In blue-ish "Pastel". Followed by apparent ♀ (visually
smaller - size dimorphism is unmistakable). She is in a blue-ish version of
Ord (+) that is the apparent ♂?

Water is getting rougher now. A begins to swell.

Both inds. go down to nest site again, and remain down all times.
Presumed ♀ usually in lead now. In brownish Ord (+). The much ♂ re-
mains behind and above during descents. They are at the Rediff Bar.
With Spoke

Now ♂ assumes blue-ish Pastel again. Goes down alone. Up. Now both

Ceph., July 1, 1981, IV

(30)

go down again, ♀ first ♂ still blue-ish "Pastel" ♀ still somewhat brown-ish. All over except for definite WT. Both up again. ♂ rises in usual blue-ish. ♀ still in brownish. But whole head and area around definitely paler, more yellowish, than back during first part of ascent. (Note: Both animals ascend tail first.) Then both animals float. Close (12") together. Resume Ord+.

The ♂ may have had WB in some or all of his blue-ish "Pastel". Now I see that there is another "pair" (or 2 ♂'s, one blue-ish just away. Obviously egg-laying is often public in this species/population.

Animals drift off. Apparently gone. I come out of water 12:45 p.m. But A and Aggie remain. And the animals come back almost immediately. Behave as before, with added complications. ♂ of pair continues to go down to inspect nest site(s) alone from time to time. At various points, neighboring animals, or accessory ♂'s rush in and attempt to copulate with the female ♀!!! From below. Attempts not necessarily successful. ♀ does not seem to be cooperative.

A also sees "roll over" upside down, copulation attempts among neighboring animals.

I go back into water 1:15 p.m. A still photo (by 2:15) is blue-ish "Pastel". Both go back to Ord+. And und. egg masses. A drifts. At least one individual, and quite probably two individuals (♂ of pair or ... other ♂?) I assume(s) "Pastel" with fin stripe, then ... fin stripe disappears. At some time, see und. stream BB. ... generally dark fin. Then there is a brief spread ...

The sort of behavior continues. ♂ of pair moves from "Pastel" to Ord+, always blue or then ♀ who remains in brownish Ord+. (This ... is not usually yellowish, or even tawny.)

Both und. retreat where A. ♀ in brownish Ord pl. ... ♂ in semi-"Pastel" plus fin stripe. Both und. lose ... retreat steps.

COMMENT: The fin stripe of this ... may well be something more than an "adjective" or "alone"!

1:25 p.m. Animals drift away. We ...

COMMENTS.

Ceph., July 1, 1981, V.

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(1) This species does seem to have fewer ritualized patterns than does sepioides. Or, at the very least, it varies them, in rapid sequences, less frequently. The generalization may hold for both sexual and anti-predator behavior.

(2). We have seen very little feeding. Does this mean that the local animals are more nocturnal, as predators, than are sepioides ???

ADDITION or CORRECTION. Actually, the term "nest site" as used above may be something of an oversimplification. Actually, the members of the egg-laying pair observed today (or at least the ♂) seemed to visit two slightly different spots - perhaps 1 ft apart from one another. But eggs were fouled at only one of the spots.

SAN.

Guam,
July 2, 1981

We did not go out for squids today.

COMMENT: It has occurred to me that many of the apparently peculiar characters of the Lessoniana of Guam may be correlated with one in a functional complex. Among these characters are:

1. Relatively great nervousness or shyness (at least apart from egg-laying sites).

2. Copulation and egg-laying (and not only preliminary courtship) occurring while the performing individuals are (still) in or near groups.

3. The ♂ is particularly assiduous in "covering" the ♀ during egg-laying.

All these might be explained on the assumption that Lessoniana is more vulnerable to predation (by marine predators) than is sepioides.

If so, then the reason for point 1. is obvious.

Copulation and egg-laying may occur in groups because isolated pairs would be too vulnerable. Very old evidence that schooling is protective.

Given the advantage of continued schooling as well as the danger of predation, then it is not surprising that a ♂ has to defend his ♀ carefully and

Ceph., July 2, 1981, II.

(38)

continuously.

It is interest in the egg-laying site may be a natural correlate, or even consequence, of the strengthened pair bond.

So may be the apparent reduction or simplification of precopulatory display.

It is also possible that the apparent reduction of "silver" displays in general may be due to their extreme conspicuousness, only too easily noticed by predators (Could "Z" fall into the same category?).

Perhaps the "Cikes" of Sepia latimanus could also be explained as adaptations to maintain gregariousness through the sexual period.

Of course, the reason why the local lanceolatus may be particularly vulnerable to predation is the proximity of deep and open water. (Bill Hunt told me today that oceanic squids are almost impossible to see during dives — presumably because they are too frightened of man's attitude.)

It will be interesting to observe the "lanceolatus" of Sepia in their semi-protected lagoon!

Guam,
July 3, 1981

Back to Glass Breakwater. Weather much as usual. Mostly sun. Occasional rain. Wind stronger than yesterday.

A starts tow from tip 9:32 a.m. Few past sites where egg-laying was seen 2 and 3 days ago.

9:38. Finds group of Sepia. 40+ Two apparent pairs of large inds. Other inds. smaller (but none very small). I go into water. The animals are near surface (again) in 6-8 ft of water over beach. All are in line in Ord. The Ord of the 2 pairs of larger definitely is "p, m". There is little or no courtship within the pairs. Inds are swimming or floating in a variety of un-interesting postures. Horizontal. Slight "Downward P". Or slight



"Upward P". All these postures observed are uninteresting.

Ceph., July 3, 1981, II.

(37)

NOTE: Among the postures apparently lacking in the local Cessomana is the ritualized Upward Curl. Why?

When I first see the inds., they are rather scattered, facing in different directions. Then they close up in line — probably in reaction to us — without any conspicuous changes in color.

All this is very dull. We stop 10:10 am. A resumes tow. Goes down to reef area. Then back to top. Once, he sees group of 7 large sepia. Twice, he finds groups of 50+ inds., but they are very speckly.

11:30 A starts to tow inside Breakwater. Nothing. We stop for the day 11:45

NOTE: Just in case it might eventually appear to be relevant, I should mention that New Moon was July 1st. First Quarter Moon will be July 7th. Full Moon will be July 17th. Etc.

Guam,
July 4, 1981.

Glass Breakwater again. Sunny. Less wind than yesterday. A and C start tow from top of Breakwater 9:27 am. A sees two large sepia almost immediately. But they disappear like a flash.

9:36. A finds 21 large sepia. In Ord + (no WS, PCA, space). General town is neutral. Really flat gray (as seen under water). No blue or blue-ish nor very brownish. The animals are approx. 5 ft up in 8 ft of water over boulders. As always very close to the bottom. When I first see them, they are strung out in line. Then they subvert. First they panic-struck. Some inds. possibly show trace of semi-"Postel" in retreat. But definitely no Fur Stage.

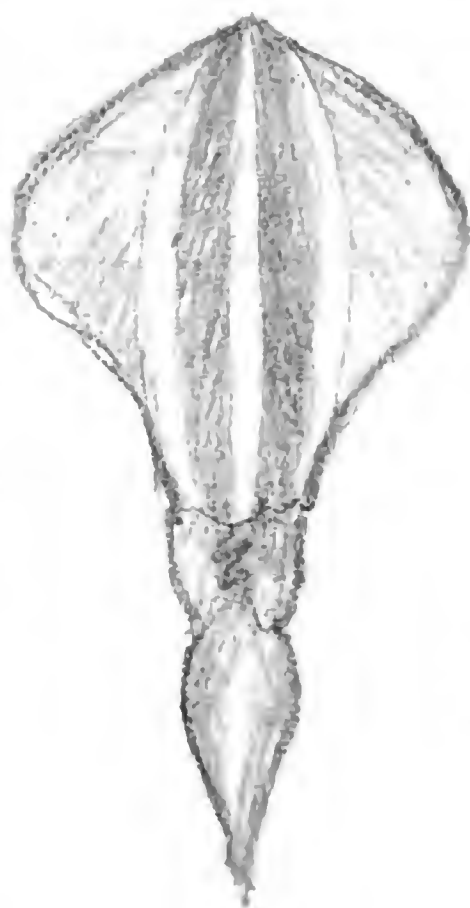
COMMENT: This sort of semi-"Postel" must be the exact equivalent and homologue of the Paley sepioides. It only looks "Postel" because the iridocytes are expanded and appear to be blue when viewed through the water. Either the local Cessomana have fewer leucophores than the sepioides of the San Blas. Or, more likely, they have larger and/or more numerous iridocytes. Viz the "Purple Bloom"!!

Ceph., July 4, 1981, II.

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Somehow, the large group splits up in the course of the retreat. Leaving (at least) one group of 10 inds and another of 14 inds. (Have newcomers arrived?)

We follow group of 14. When we catch up with them, at least one ind. is in a form of Ord which appears to be almost "semi-double streak". Dark of back is concentrated above (perhaps even darker than usual?), leaving sides of back light. This is, in this particular case, rather conspicuous because the fins are simultaneously dark all over. Several other inds, in more or less Ord, have retracted BB, just along borders of fins.



← Could this be an adumbration of the usual spread pattern ????

One ind. advances towards sandbar. In Ord +. With definite WT. Ord tips of tentacles are split.



Now ind. is in Ord with 10-15 g. rights

The ind. retreats in the end without striking.

There are no signs of continuing with group (although A did see a spread. SAN).

Animals disappear 9:50 a.m. A & C resume 10-

10:06. A sees large B. ind.

10:12. A finds "nesting pair" of dipods. In shallow water over boulders next to Breakwater. The pair is just 3 dipods + 2 inds, a few yards apart, in rapid succession. Obviously prospective. They move on.

We find pair again a few minutes later. They now (very rapidly?) have selected a definitive site. The animals are now in a small pool. In swell and almost in air bubbles. Difficult to see - at least to follow. Site is perhaps 8 ft down. Perhaps less.

The actual behavior of the animals is difficult to determine in detail, but the general outline is clear.

Ceph., July 4, 1981, III.

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The ♀ makes repeated visits to hole or crevice of site. At intervals (of only a few minutes). Usually stays at site approx. 10 sec. (according to C). ♂ usually follows her down, but never (as far as we observe) actually enters the crevice or hole. He usually remains hovering a foot or so above the ♀ during her visits.

NOTE: A uniparous site early in our observations. Apparently no eggs at this stage. But eggs must be (being) deposited later.

Between visits to site, the ♂ and ♀ hover together half way up water column.

The ♂ usually is in gray and/or blue (dark +?) while hovering with or without the ♀. The ♀ has similar coloration when she hovers with ♂ in water column between visits to site. But she turns brown (and probably darker) when she goes down to site. And this color is maintained during the first part of her ascent after a visit.

Occasionally, the ♂ follows the ♀ further down than usual. When and if so, he also tends to turn brownish at her water site level, at point of his descent.

These colors certainly are adaptive. Quite garish, cryptic. Gray or blue (dark) is difficult to see high in water column. Brown may resemble boulders low down.

Once, at least, the ♂ does exaggerated flutter (f. 6. 11) while hovering beside ♀ relatively high in water column, between visits to site.

Once the ♂ follows the ♀ almost to site. And he assumes full Bar while he waits outside crevice.

A starts to film 10:45 a.m. I back off.

10:55. Both inds. of pair lost a small and brief retreat. In semi-"Pastel". Probably no Fur stripe. But the animal came back immediately and resume behavior as before.

NOTE: These animals are doing little or no Head-riff Bar.

♂ assumes extreme full Bar, apparently well E, when A moves in to photo close up.

I get out of water 11:10 a.m. A continues. He starts 3 rolls of film, and completes 1 roll of color stills. He sees a great variety of high intensity re-

Ceph., July 4, 1981, IV.

(42)

actions. Copulations, apparent escape attempts (there are other larger in the neighborhood!), spreads, "Gold" displays, more laying, etc. etc. etc.

SAN.

At some point in this period, C sees a skipjack attack and take another Sepiet some 20-30 ft away from pair.

We finally leave area 12:40 p.m.

June
July 5, 1981.

We try Ippao beach this morning. Enter water 10:12. Sunny and windy. Bottom here is sand, rock, and coral. A has seen Sepiet here before. The area is certainly loaded with fish. But today the tide is high, the currents are strong, and there is considerable surf. We give up at 10:40.

June
July 6, 1981

Going to try some night work. Glass Breeze water. Almost tip just before sunset. See is rather calm.

A begins tow 6:48 p.m. Almost immediately, he sees groups of 2 large Sepiet. They disappear. Then he sees groups of 8 young Sepiet.

Now resumes

fun set by 6:57

A tows all the way up to surf, then part way back. No more squids seen.

Then we drift, shining light from boat. 7:25 p.m. Another "separated" A few fish come in brief. But no squid.

A resumes tow, with light, 8:00 p.m. Nothing of interest. We stop 8:15.

COMMENT: The apparent absence of Sepiet here at night probably is real. The animals may well have gone out and perhaps into deeper waters. This may be when and where they do most of their feeding. (Certainly the presumed feeding attempts that we have seen during the daytime here have

Ceph., July 4, 1981, II.

(43)

been minor - not enough to keep body and soul together.

According to Frankie at the lab, this is the area where day water is closest to the island. The abundance of sepiots here in the daytime may be correlated with this fact.

NOTES: We have been trying to identify some of the local fish.

① The species usually called "skipjack" here is Katsuwonus pelamis. It is a tuna.

② The halfbeak which A has seen with sepiots is the "Short-nosed Halfbeak", Melapetalion breve.

③ The goatfish with sepiots is more of a problem. It resembles the slender Goldband Goatfish, Mulloidichthys flavolineatus; but it has a black spot on side.

These "identifications" are based on:

SCHROEDER, R.E. 1980. Philippine Shore fishes of the western Sulu Sea. National Media Production Center, Manila. 246 pp.

JOSEPH, J., W. KLAWE, and P. MURPHY. 1980. Tuna and Cullfish. Inter-American Tropical Tuna Commission, La Jolla, California. 46 pp.

Quana,
July 4, 1981.

Back to usual Glass Breakwater this morning. Sunny. Moderate wind. A begins tow from tip 9:17 a.m.

9:23. A finds group of sepiots. Group probably is large. Seems to include at least 1 pair of Larges. One of the members is bright white toward the rear of the body. This could be an immature RL. It is more likely to be a scar. The members of this group keep retreating before our advances. Slowly, I think, in some sort of Ord-type coloration.

I get out of water 9:38. A continues tow.

9:52. Almost exactly same place where egg-laying was seen last day (of my usual field work - June 30th). A finds another (apparently) breeding pair. When I get into the water and find the animals, I find that there are

Ceph., July 7, 1981.

(44)

3 inds. The apparent pair and an outrider. All very high in water, almost at surface, in approx. 6-8 ft of water over boulders close to shore. (This sort of habitat preference - during the day - seems to be very strong indeed!) The members of the pair are no more than 1 ft apart from one another. The outrider is perhaps 10 ft away from the pair. All 3 inds. are in more or less Ord. They drift away or retreat before us. Not rapidly. No conspicuous color changes.

NOTE: I find these animals extremely difficult to see at any distance. It is (again) my impression that the local leisonomus are much more frequently (or cryptically) cryptic than are the sepioides of the San Blas.

A's eye (for squids) is better than mine. He is seeing something. He says that the members of the pair have already made at least one descent.

Then I see another descent. One member of the pair (presumably the ♂?) goes down only half way. Goes blue-ish during first part of descent. Then shows Midriff while hovering. Resumes Ord (+?) on rise.

NOTE: It is quite remarkable how little white, pale, or silver that these animals show in circumstances of this type. Obviously an adaptation against predators.

10:14 Pair move away. Only briefly. Back almost immediately. They are still very obscure to me. But A says that the relations between the ♂ and the ♀ of the pair are rather peculiar. The ♂ seems to be much more active about egg-laying than is the ♀. He goes up and down more frequently than she does. ♀ seems to be reluctant to enter crevices.

COMMENT: This is good evidence that "♂" indicates "nest site". It even suggests that he may choose the site.

10:30 Get fairly close to the animals. Now there are 4. Apparently 2 pairs. All more or less in Ord (+?). I see some interaction between pairs. Advances and retreats. With little or no color changes. But some "showing" and "pointing".

Especially, I think by the ♂ of the pair that I've been following most of the time since 9:52.



find any.

A finally goes forward to look for eggs 10:28. Doesn't

Ceph., July 7, 1981, II.

45

A comes out of water 10:45. Aggie tows back toward tip. Nothing of relevance. We stop 11:12 a.m.

Guam,
July 9, 1981

Going to try a new area this morning. Looking for "Double Reef" approximately 3 1/2 miles north of Tanguisson ("LCS") beach. The weather is clear. Mixed sunshine and rain. Winds are light. The sea is unusually smooth.

A starts tow general area 10:40 a.m. Finds group of Sepiots 10:52. Approximately 12 inds. of medium size in 20 ft of water, over sand and rubble. They move away. I get out of water. A continues to follow. They are dull.

11:05. A resumes towing. We zigzag back and forth in an attempt to find Double Reef. (NOTE: a local diver has told us that he often sees Sepia latimanus in this area.) We are not particularly successful. A finds something which might be the reef in question ca. 11:25. But it is 50 ft down.

NOTE: A says that water is unusually clear here, except near the face where it is often "muddy". This may be typical of many areas around the island. If so, it may help to explain why the local Lissonotus often go high in retreat. They are trying to disappear from the view of a predator (in the water).

12:20 p.m. A finds another group. 30+ inds. At least 2 large, but most of the animals are medium to small. Very close together. High in 3 ft of water. In diagonal line (no conspicuous size gradient). All in "Dark". Rather dark and brownish. Several have spots. No Y or SCA or W/S (definite).

Most of the animals seem to be resting very peacefully, and they are not bothered by us. I.E. this close inshore environment must be relatively safe for them, at least during the day time.

None of the inds. makes any attempt to feed.

Perhaps this rather dark brown version of "Dark" is equivalent to some of the "Darks" of sepioides ??? If so, it is interesting that it is less exaggerated in form (it is not so extremely dark). It is not only the light pattern of this species (or population) that are comparatively simple.

The fins of at least some inds. are also semi-dark. And so are the

Ceph., July 9, 1981, II.

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in bellies.

All in the mds. assume mild "upward pointing" and "downward pointing" postures from time to time. I think that all these postures are unritualized. The animals are simply rocking in the swell.

One ind. has a conspicuous white spot on its "tail". This could be RL; but (again) I think that it is merely a scar.

Then one ind. shows a "new" pattern. A trunk along side of body, more or less at base of fins, turns bluish "semi-Pastel". The effect is slightly - but only slightly - reminiscent of some Double or Quadruple Strake patterns of sepioides. I doubt if any strict homology is involved. The same ind. turns bluish "semi-Pastel" all over, or at least on the back, while it makes a sudden retreat of a few ft.

I see that there are many half-beaks with the squid now. Not the short-billed species (see p. 43). These animals have a comparatively long bill. They are just below the surface, usually higher than the squids. The two species may not be really integrated, so to say, but they certainly are very close together in space. Perhaps the half-beaks have also taken refuge in order to rest?

ADDITION: the eyes of the squids here are pale. Conspicuous against the semi-dark of the head and body. But not at all shiny. And still are?

Every once in a while, an individual will do some thing of the arms. Presumably cleaning.

We gradually drift closer to the animals. I notice that the ecdys on the back are conspicuous close up. Look blue under water.

(Again) an ind. shows bluish "semi-Pastel" with a just at

NOTE: there are numbers of sardines around. But they are comparatively large. And the squids show no interest in them.

A goes for his gun and re-approaches group in order to collect specimen. First, 2 inds. retreat slowly below him with bluish side to side (as described above). More case, the bluish spreads over whole body of body (a sort of "pseudo-Pink")

Then 10-12 members of a whole sub-group dash for full "semi-Pastel".

A notices in on one particular pair. (Presumably a real pair). Later on, both A and Aggie see the same inds. prospecting an egg-hole. Perhaps even copul.

Ceph., July 9, 1981, III.

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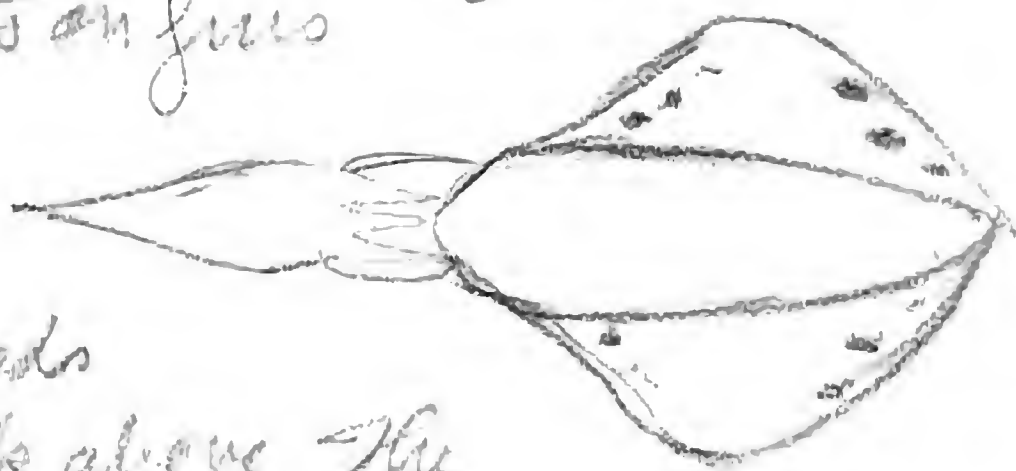
ating. SAN.) The members of this pair retreat slowly in "semi-Pro E" with extreme Y (silver as usual). Is Y higher intensity in Lycoteuthis than sepioides? One ind. (the ♂?) then changes into Midriff.

COMMENT: these patterns in these circumstances obviously have a purpose. We may assume that some or all of the color patterns that we see during courtship and egg-laying are really alarm rather than sex.

A shoots at one of the members of the pair. Misses. Pair retreats several meters, no more. (And there are still other members of the group around in the background. The animals are really difficult to speak in these particular circumstances.)

A follows pair and approaches again. (Now is when the sexual behavior was seen.) Finally shoots 12:45 pm. Successful. Gets the ind. which was doing what we assume to be the ♂ role.

I see the animal on the spear immediately after being shot. Dark. Light below. Fin with conspicuous, sharply defined BB outside. Narrow WB inside BB. Also black spots on fins.



The animal also partly spreads arms. The top arms are dark above. The bottom arms and/or the bottoms of the top arms are conspicuously light or white. (NOTE: this complex of patterns certainly is reminiscent of the full, regular, spread display; but I am by no means certain that it is identical in all respects.)

After some minutes, the animal is obviously overboard. Generally colorless. But with extremely emerald green form of Y! (It looks as if Y looks so silver in the field.)

ADDITION: The measurements of the collected animal were as follows:

Mantle length: 180 mm

3rd right arm: 73 mm

2nd right arm: 48 mm

1st right arm: 63 mm.

Ceph.

Guam,
July 10, 1981

Going to try same area (north of Tanguisson) again this morning. Weather clear and hot. Sea is very smooth.

Starting towing 10:10 a.m. Along a considerable stretch of coast. Then we find the real Double Reef. Circle around and continue. Nothing of interest

11:53 a.m. Aggie finds a large group of sepia's. 45 inds. Ranging from large to fairly small. Apparently no newly hatched or "larval" types. In more or less shallow water (3-10 ft down) very near shore, over coral and mixed sand-coral bottoms. All strung out in wavy lines. Probably include several sub-groups, but not easy to distinguish.

When I first see inds, they are in "neutral" Ord +. With at least WS and a trace of PCA. Definitely no Y. (Y must be higher intensity in this population than among the sepioides of the San Blas.) Also slight red around tentacles

Then all the individuals that I can see go dark (= dark brown Ord of some earlier notes). At the same time, they allow me to drift closer to them.

This sequence is suggestive. Ord + probably contains an element of alarm which is absent (or weaker) in the "resting mid-day dark".

One ind. advances slowly toward me and up to me. Extending arms and perhaps tentacles. Then accelerates almost vertically. Stops abruptly, then slides down again. There was no real strike by tentacles, but the whole behavior certainly looked like feeding. The animal may well have caught a cep. pod or some other small organism. In any case, it remained in dark then went.

Now I see that there is some "coasting". One ind. does extreme E without color change (i.e. still in dark). Then proceeds slowly & somewhat together. The o³, at least, shows a trace of blue-ish semi-dark.

Then I see another E. Plus 2 more E's in succession by another ind. Then an E by a (third or fourth) ind. E's obviously are common in this population. Presumably low intensity. Difficult to tell what provokes them. Possibly only a slight approach by a neighbor.

The darks certainly intend to feed and belly. The cells on back are sometimes conspicuous (clear up); sometimes not. This variation may be an effect

Ceph., July 10, 1981, II.

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of light rather than contraction and expansion of pigment cells.

More E's in distance.

One sub-section of groups makes brief retreat in "semi-Pastel". I notice that belly is lighter than back in this pattern.

Watching 4 inds., perhaps 2 pairs, at one end of line. They all go from Dark to Ord +, with WS, PCA, and conspicuous WML. Then one animal is "semi-Pastel". At which point, there is brief, very rapid, interaction which I cannot follow. Perhaps including spread. I can't see accompanying color, but it certainly is not (full) Z.

Another E in Dark. NOTE: E's are usually performed when an animal is stationary, descending, or advancing. Seldom or never when it is going backward. Was this also true of sepioides?

One ind. suddenly turns Silver below and at least Lateral Silver above. (Actually, I would not be surprised if the upper pattern were Bilateral.) Nothing more happens; and the individual quickly resumes dark.

A starts photographing 12:25 pm

Several inds. retreat slowly with a "Pastel RL" in Dark. Quite definite. At same time, belly may become slightly lighter (and reddish in tone). Then I see more "Pastel RL"s. Obviously a low intensity indication of full "semi-Pastel".

12:43 A sees courting couple in group. SAN.

Then I see burst of "courtship" in sub-group of 6-7 inds. Swimming back and forth in short arcs. Not really Rocking. Frequent brief accelerations. Miscellaneous "Pastels". One (B) Lateral Silver. Also one "strike" (cop?) from below.

Some distance away, I see an apparently single ind. making repeated descents (some with E's) toward what may be a (prospective) retreat site. Could this be mate of ind. shot yesterday? Its behavior is rather more reminiscent of a ♂ in a pair than of a ♀ in a pair.

Then find group of approximately 12 short-finned Halargulus in the sepioid group. The fishes are all bunched together. Only a few inches apart from one another, at best. They are much closer to one another than they are to the nearest squid. Or than the squids are to one another. But they are

Ceph., July 10, 1981, III.

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definitely well integrated members of the mixed group. Move back and forth with the line of squids. (Although they are not always facing in the same direction. After all, they cannot swim backward.) According to Aggie, these half beaks were already with the group when it was first seen at 11:53.

The half beaks are near center of group. I.E. They probably are associating with the squids rather than the reverse.

I get out of water 1:05 p.m. A picks up shortly afterwards

Guam,
July 12 and 13, 1981.

Yesterday we went north from the Agaña yacht basin. Windy and rough. A begins tow from Dos Amantes Point around Tumon Bay 10:38 a.m.

There are lots of divers in the water here

11:00 a.m. A sees group of approximately 8 Medium Squids. They leave immediately.

11:20. A sees octopus in display. In flamboyant with papillae erected and conspicuous. Then turns dark with white line down center (between eyes). Then escapes into hole. This display may have been provoked by 4 or 5 adjacent goatfishes who may have been bothering the octopus. (Note: these goatfishes probably are not the same species that associates with Leptoteuthis leucanota.)

A little later and further on, A sees 2 more Squids. Again leaves them almost immediately.

Tow continues past Ypao Point.

Stop 12:00 m.

This morning we went south from Agaña Basin. Sunny and less wind than yesterday. A begins tow 7:14 a.m. Continues almost to Piti (with a detour around Camel Island). Less wind 1 speed. Stops 10:20 a.m.

ADDITION: I have been talking to a student at the Agaña Yacht Basin. His name is Rob Myers (spelling uncertain). He has some interesting information:

① The Short-jawed Wolfbeak Megajulidion bruce has not yet been

Ceph., July 13, 1981, II.

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recorded officially from Guam.

(2) The goatfish with sepia is probably Mulloidichthys
flavolineatus. According to Myers, ind. of the species sometimes have some-
times do not, have black spots (see p. 43). He also says that the black spots
are typical of solitary individuals, while ind. usually do not show spots
when in groups of their own species. Are the spots hostile? Abouin? He
says that the goatfishes with squid are seldom or never accompanied by
companions of their own species — and yet they do show black spots. Why?
Are they intimidated by the squid?

CephalopodaPalau,
July 15, 1981

Arrived Palau this morning. Staying at Micronesian Mariculture Demonstration Center on Malakal Island.

There were Sepiids by the seawall this morning — just as in 1979.

We did not have time to make observations today. But we did talk to some of the Palauans who work at the lab. One of them (Mara?) told us two interesting things:

① Local fishermen catch the squids (presumably sepioteuthis) with hooks attached to lures carved to look like shrimp. Some squids go for small shrimp. Large squids go for large shrimp.

② Local fishermen also spear squids at night. They find the squids in groups in the shallows!

Malau,
July 16, 1981

A looked along the seawall here ca 6:30 am. The squid got I start out along wall myself 7:15. Color 1.5 to 2.0 ft. 7:33. See group 7-8 medium-small sepia. Height 1.5 to 2.0 ft. column clustered near rear of boat (tinting white?). More 1.5 to 2.0 ft. pale-ish (paleish?) Oct & suddenly all water. Squid water to top of 2 disappear from view — temporarily.

NOTE: Bruce Saunders says that he also has seen squid by the wall. Possibly apart from the squid.

Group of small medium-sized sepia in 1.5 to 2.0 ft. water. Just in darkish Oct (?) Then turn pale, 1.5 to 2.0 ft. approach boat again. Then disappear again.

NOTE: Saunders says that he has already seen a number of local squids and cuttlefishes to Papua.

COMMENT. On the little evidence that I have seen, it would appear that cuttlefishes and squids are closer here than at Ife.

Ceph., July 16, 1981, II.

53

7:45 Wind rising a little. Direct sunlight is beginning to reach this area (sunrise was before 6:00 a.m.).

Lots of sardines in inlet at end of wall.

Stopping 8:20. Too many ripples in water.

12:05 p.m. Walking along seawall again. Group of 40+ Sepioteuthis. All in diagonal line. Small (in front) → medium or medium-large. Some distance below surface. All in dark. Observed, backing.

Becki (spelling?), one of the technicians here, catches (with hook) 5 of the squids in rapid succession. Using black shrimp-like lure. I.E. these animals certainly are prepared to feed in the daytime!

We keep one of the squids for identification.

This afternoon we go out by boat. A very extensive survey, from 1:35 to 3:20 p.m. Along shores of Winkstrapel, a rock island south of Malakal; then along south shore of Malakal (including seawall of Center); then along a rock island (name unknown) west of Malakal. Visibility is not very clear, and he does not see any squid or cuttlefish.

Palau,

July 17, 1981

A got up early this morning. Before 6:00 a.m., just getting light. He sees group of 7 large Sepioteuthis by seawall. Apparently he is looking for them. He does feeding advances, but no actual capture. But the squid are certainly irritated as if they were being attacked. The squid seem to be very nervous. One between advances. Perhaps through collection (hooking) of squid during advances.

Taken at 8:35. A single group Sepioteuthis in inlet. At least 8 large, some smaller. In the inlet, he does a large number of advances.

When I start observation, 8:40. Group is still there. All in one or less in Ord +

Retreat before coming up with little or no change.

Ord + includes WS and PCA. Also speak in some cases.

NOTE: Becki is already catching more squids down to wall.

Ceph., July 17, 1981, II

(54)

We probably caught 30 inds. yesterday. The population of Sepiots must be enormous here to withstand this sort of pressure.

8:57 Group includes at least 15 inds. Relaxed and dispersed now. Inds. may also be turning slightly lighter. WS and PFA no longer conspicuous. Calangids seem to have gone. And feeding has stopped (at least for the moment).

NOTE: it is cloudy today. May help to explain absence of dark.

One ind. turns briefly yellow - w/ slight retreat.

Something - not the squids - is making Sepiids jump by far bank. WS has also reappeared on squids. Is this coincidence?

I walk along seawall for a while. Come back to find group as usual still behaving as before. All very placid 9:12.

Calangids back. Several squids go Dark immediately. But they do not retreat.

Then squids retreat in light - w/ when someone steps particularly closely. Relax again.

No sign of courtship (yet).

One ind. turns "brown" with conspicuous WS. Then immediately very Dark. Then immediately back to Ind. w/ This ind. has companion in dark. Was the interaction hostile?

Walk along seawall again. Nothing of interest. Back to inlet. Everything just the same 9:40.

2 adjacent inds. go Dark, briefly, simultaneously. This sort of performance is common, I think. Some adults do seem to be "lost R."

Stopping 9:55 a.m.

11:20 Group of 20 large Sepiots by seawall. In dark. Ind. HAWES (4 female). Basking "on surface" (Ind. is low - fence - against). This may be group in inlet earlier. (Inlet seems to be empty now).

NOTE: ind. ejected in water earlier - possibly much earlier - is retaining consistency remarkably well.

We decide to go into water 11:37. First swim over shallow "sand" just west of Center. Water is murky. No cephalopods visible.

Then we take boat and go out to Winkthorpe again. A tow along

Ceph., July 17, 1981, III.

(53)

outer shore (we did the inner yesterday). A starts tow 12:40. Finds one small 12:50. Then a small ink blot a few minutes later and a few yards further on. Nothing more. Gets out of water 1:33 pm.

We see 2 additional snails, close together, on way back along same coast.

COMMENT: the typical "rock islands" here would appear to be poor in sepiots (except possibly fairly well developed young). Why? Perhaps because the fall-off from them is too steep ??? (Note that there is a gentle fall off, with sand and coral in front of the seawall of the Marine Culture Center here. And, although there was very deep water nearby at some of the sites where sepiots were found at first, the individuals observed were always - at least usually - in shallow waters at the times of observation.)

There are sepiots, basking in Darks by seawall when we get back to Center at 2:30 pm. Tide very, very low.

I go out to seawall again 5:00 pm. Tide rising now.

Nothing visible by 5:25 (but reflections on water are very bright).

Out again to seawall 6:18 pm. Lots of blue-ish or orange jumping about. Apparently a feeding frenzy! Then they all come off. The pursuit of squids? No ink in water.

Lots of noddies feeding farther out. On sandbars?

Nothing else of interest visible. Beginning to get dark now. Stop 6:32 pm.

Palau,

July 18, 1981

Out to seawall 7:35 am. Tide in. Little or no wind. Water muddy in inlet.

8:04. 2 nodules or small nodules show up. High in water. 5 ft apart. In Ord with Y (little or no WS). Apparently making feeding advances. Not very vigorous. In cypriotes.

Then A finds large group (43+), further down wall. No cypriotes and large tower in water column.

Apparently gone when I get there.

Ceph, July 18, 1981, II

(56)

Stop 8:30 a.m.

Start with boat 9:00 a.m. A tour back and forth near Center. Over very extensive sand and coral. Slope is gentle.

There are many blobs of ink, of all sizes, here. Is this profusion significant? Are the Squids here particularly heavily preyed upon - and/or particularly "spooky"?

In the course of this tour, A sees one group of 13 Sepiids, large to medium. Also another group of 24 smalls. S.A.N.

Becker starts fishing and so we go out to other areas. Channel between Malakal and Koror. Then out to offshore islands, within lagoon, lee side of the archipelago, more or less facing channel. Again A tours over great variety of habitats, mostly coral and sand, some TG (apparently not Thalassia - more like Enhalus in appearance). Water murky in some places; quite clear in others. A sees several small groups of squids and/or ink blobs. Nothing of real interest.

We stop work 12:05 p.m.

NOTE: We are still failing to see any very young "larval" Squids. Why? It might be supposed that the young of P. m. m. hatch at a more advanced stage than do those of sepioides. But this seems unlikely. According to A, the eggs of Leiomana appear to be approximately the same size as those of sepioides.

Out to seawall again 4:30 p.m. Tide very low. Some ink blobs around. But someone says that they have seen squid.

Then I see groups of large Sepiids. All very near Cultura. All in pure Dark. One suddenly shows lateral filament and swims off to another. Then Dark again.

I go into water 4:15 p.m. Visibility is not good. By the time that I get to the appropriate area, the Squids seem to have gone.

I swim up and down the length of the area, without seeing any cephalopods. But A tells me that the same group of 7 large Sepiids appeared again after I had passed.

Out of water 5:00 p.m.

Palau,
July 19, 1981

Out to seawall 8:25.

Almost immediately see group of 34 large-ids. Banded close together. Barking near surface in semi-dark with little or no WS. Then all retreat in pale-ids. With Y, I think. Then relax. Then off again without color change.

I walk back and forth along wall.

9:00. Group reappears same place as before. Now in diagonal line. In semi-dark again. Then scatter a little without color change. Drift away again.

Some minutes later, I see large school of carangids 100 ft along wall.

Group back 9:20. Barking in Dark. Puller scattered. Some indication of pairs?

One ind. shows brief, faint, Bilateral Silver. Another shows brief trace of "yellow".

One ind. backs toward another. Generally darkish, but few have gone light and transparent with conspicuous diffuse BB.

Then all sink down, going slightly lighter, into neutral area. Is this cryptic? All inds. are facing out into lagoon. Does two have 8. Is there predator in lagoon?

The inds. stay down, but gradually get darker.

Brief retreat with slight paling. Back to darkness. Out to surface 9:32.

All dash away in "pale". Back again in Dark. Then go down and turn Over again. Still little or no WS. Up and back again.

COMMENT: These inds. go down to go cryptic. Unlike the animals at Guam which went up.

NOTE: inds. tend to keep relative position in line. One large with scar is usually 4-6 positions from one end of group. Larger inds. are usually clustered toward center.

Group is decreasing. Now only 12. 9:45. Then more drift in again.

Ceph., July 19, 1981, II.

(58)

NOTE: Jaws definitely are dark all over in usual Dark.

7:50. Breeze coming up. Ripples on water.

Still no trace of courtship of any appreciable intensity.

Taking a break 9:00 am. Back 10:30. Tide going down. Water still rippling. Squids apparently gone from former site.

Huge school of sardines in inlet. Apparently no squid. But these sardines are being attacked by school of carangids.

Stopping 10:50 a.m.

Go out to lunch. Come back ca 1:15 pm. To find that Jerry has caught a tiny little cephalopod. In about 1 ft of water over ramp at (Marine Resources Development Board) boatyard in Koro.

General shape is Sepioid and/or cuttlefish like. Shining light on the animal in lab, it appears to have something like a solid cuttlebone inside. But it also seems to have 2 little fins approx $\frac{3}{4}$ of the way back on the body!

At the present time, the upper surface of the body is generally brownish yellow, thickly and almost uniformly covered with small light (white and/or iridescent) round spots.

The animal would appear to have a mantle length of approximately 8 mm. Head and arms possibly also 8 mm.

When I look again, the animal has turned more or less yellowish colorless.

Actually, the animal looks too elongated to be a larval Sepioid. Nor does it have the relatively few and large chromatophores of larval sepioides.

Sometimes hangs head down (straight).

According to A, shows occasional flashes of lighter or darker. Also "fin stripes" (along whole side of body) and down sides of arms. See A's drawing.

In microscope dish, the animal goes absolutely colorless to the naked eye. Transparent jelly. Under microscope, however, one can see many black chromatophores in extreme contraction.

Animal remains colorless, under to bottom of tank. Seems to be dying.
2:25 p.m.

Ceph., July 17, 1981, III

(59)

Then the animal starts to move around. Jerkily and abnormally. Still in colorless almost all the time. Occasional very brief, instantaneous, flush of dark. Turnout light and leave animal alone 3:00 pm.

Still alive at 3:45. Then Leray puts in warmer water. Animal partly revives. Starts to swim above bottom. Begins to get a little color. So we take aquarium out of air conditioned room and put it in room without air conditioning.

4:04. Now animal has gone colorless again. But it is definitely swimming, jerkily, above bottom.

We ladle in more natural sea water. Animal becomes more active - probably in reaction to disturbance. Once it jumps, shoots away, briefly turns full dark. Then colorless again. NOTE: its colorless may have a tinge of yellow now. 4:20.

Now animal is swimming less jerkily. Assumes diagonal head-down posture. Once extends tentacles. Feeding on something microscopic?

Still in colorless, shows occasional trace of "fin stripe" and of dark lateral arm stripes ("LAS"). Eventually, these become semi-permanent. Then animal rises toward surface in head-down.

This is at least a partial recovery.

"Fin stripe" usually or always restricted to rear half of body. Could they be related to DM of other species? Animal also begins to dash (to something like Ond of Sepiote) spontaneously from time to time.

Almost touching surface now - 4:38

Angle of usual head-down is

This posture probably is not met as a signal.

Sometimes almost vertical "verticalized" - at least



Obviously watching me outside tank.

Yes! "Fin stripe" as shown at present (possibly different from stripe shown in A's drawing).

Sometimes shows tendency to curl distal parts of arms downward. In a sort of adumbration of an E.

There is no doubt that this individual prefers the surface where it is undisturbed (and healthy). Goes down a little when new water is poured in.

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(60)

Now protruding tentacles, usually only part way, in regular and rather rapid rhythm. Tentacles are often dark with White tips. They also appear to be entirely dark on other occasions. Once apparently in response to my approach. Sometimes the tips of the tentacles are spread and curled like hooks. Usually with dark?

The animal seems to have chromatophores within the body as well as in epidermis.

Now there are more instances of continuous Fin stripes. Are Fin stripes and DM poorly differentiated in this species and/or at this stage?

Later on, arms and tentacles are often partly retracted. Into a blob. Terminal and subterminal dark of tentacles quite invisible. This might be a sign of relaxation or "sleep".

5:31 Animal extends tentacles several times again. Then times, the tentacles are entirely colorless. I.E. both dark and WT of tentacles at other times are actually assumed.

Once the animal protrudes arms in "Anchor" while they are (still) entirely colorless. Definite.

Then does the same thing again and again. This obviously is important. After each Anchor protrusion the tentacles are down into the cone or blob of the other arms. Looks almost like "sinking". Is it trapping food adhering to the tentacles when they are spread in anchor? Or tentacles sticky?

A photo 5:45 pm

GENERAL COMMENT: the colorless or semi-colorless of this animal seems to be a sign of (relative) relaxation. The dark seems to be a reaction to disturbance. Sometimes, at least, accompanied by retreat (insofar as the animal is able to retreat in its present circumstances). Possibly a Pale for retreat will develop as the animal gets older?

More Anchors. Usual form is more extreme than diagrams above. Comme ça.



perhaps sometimes larger

No real signs of "studies" as in the feeding attacks of Sepioteuthis and Sepioides.

Ceph., July 17, 1981, V.

(41)

Several times, animal approaches wall of cage, arms first, repeatedly. Could it be picking something (food) off walls.

Observations interrupted 6:26. Noah has found a sepia off near air. I go to look. Really just a grayish mass in this light. Almost on bottom. (Tide is getting high again.) Apparently alone. Certainly no sepioteuthis visible in the neighborhood. Gradually moves on. Lost to view.

NOTES: Noah says that this animal is less than half large adult size. He also says that it is typical for the cuttlefishes to come at dusk and leave at dawn.

Back to our small captive 6:37. Still behaving as before.

6:45 p.m. Leroy puts lots of microscopic food in aquarium. Our animal starts to feed immediately. Mostly "rubbing" at the walls; i.e. repeatedly approaching and touching walls (bumping into them) with its arms - not the tentacles. Leroy thinks that it may be taking clam larvae.

We turn out lights and leave 7:10 p.m.

I think that I will call both the individual and the species C. kear for the time being.

We go over to look at C. kear 8:20. Without turning on the lights. The animal certainly is not bioluminescent. So we use our flashlight. Find the animal high in water column, backed into corner, in "Dark" or semi-dark. Turns lighter when we shine light on him. All the time, his arms are in prob. We leave immediately.

NOTE: It is conceivable that sepia and sepioteuthis share the same close inshore habitats by alternating night and day.

Palau,
July 20, 1981

Out to sea wall 8:30 a.m. Just getting light.

The cuttlefish seems to have gone. All the sepioteuthis apparently have not arrived yet.

8:53. Now we see large group of sepioteuthis. About 20 ft from wall. A sub-group comes closer and then disappears again.

6:07. Oscar seems to be alive and well. Near surface. Infinitely yellowish colorless with Blob. Then starts to nibble from walls, just like yesterday. Still using arms alone — or tentacles retracted so that they do not protrude visibly beyond the (other) arms.

Feeding low as well as high on walls.

NOTE: aquarium is Japanese, but approximately 10 gals.

Nibbling is more constant. But I have yet to see an anchor this morning. Is nibbling common in wild? If so, the species can hardly be a pet water at this stage in its life history.

6:22. Now the animal has definite fin stripes while feeding. The stripe was not present earlier.

Most of the nibbling head and arms are

Comme ça:



ing is not in head-down. Body is tilted, but bent at an angle.

Stopping observations 6:30

6:32 a.m. Fresh feeds & cuttlefish. In approximate area where one was seen yesterday. Mass of enormous star worms (old Quasnet Hott?) Covered away the one seen yesterday. The other is (even) smaller. About 15 ft apart from one another.

Both are very placid. Just hovering above bottom in usual dog resting posture, arms perched downward and tucked in.

When first seen, both inds. are in sort of muddy, semi-mottled "End" incredibly cryptic. After a minute or so, larger ind. turns down, with more white papillae all over back. And comparatively light-colored mottles 7 & 8.

6:44 Group of 10 Sepiids (large-ids) appear. They are just over or close directly over cuttles. But the 2.34. (see above) — close to the top. I think a high wave. Water probably 10 ft deep. Squids are in dark. The smaller ind. is staying in same color throughout. The larger cuttle shows "center" or "sordid" Bar (i.e. part of back turns lighter than it was). This could be coincidence, or a reaction to the squids, or (perhaps more likely) to a surge of waves (a motorboat has passed by).

Group of Sepiids is now 21. All of them at surface. (Note that today is cloudy, not bright sun) The Sepiids drift over the cuttles. No visible re-

Ceph., July 20, 1981, III.

(43)

action by anyone

6:50. Larger cuttle changes color. Head goes paler. Develops light contour bar across back. And papillae disappear. A says that animal caught silver fish at this time. Then the animal goes back to "usual" dark with raised white jaw line.

One eyebrow of the larger cuttle is consistently lighter than the other eyebrow. Could this be scar?

6:58. Sepia's seem to have drifted away for the moment. The cuttles are still sitting. Then one turns dark all over - i.e. lowers papillae (?). Just a brief flash. Goes back as before. Both cuttles seem to ignore passing fishes (none of which are small ones).

Papillae may be getting gradually less conspicuous now 7:00

NOTE: the quidors here look rather like the sides of large palm leaves. According to A, some of the cuttles of Guam tend to hang around similar palm leaves.

Leaving temporarily 7:10

Back 7:30 The 2 cuttles are still here just as before. CORRECTION: the smaller cuttle may have gone. (At least, I can't see it. But the larger one is still visible from our point of view).

The large school of camouflaged swimmers by. Shows up into it in cuttle but the cuttle does not react to them.

Papillae of cuttle certainly are relatively less conspicuous now.

Stopping again 7:50. Go over to look at Cuvier. Also still very much as before. But perhaps feeling less active. In pure colorless at first. Then the fins conspicuous. Fin stripe and arm stripe. These are eventually (or usually) continuous with one another. I can't see what purpose these perhaps have (perhaps very apparent?). But stripes soon disappear. Back to colorless. Arms in back. And animal goes back to milking.

Why are there no Arm bands today? (Change in food supply?)

Now the animal is just floating half way up in water column. In large al head-down. Perhaps resting. But still in colorless. No trace of stripes.

Suddenly shows Fin-Arm stripe, briefly, when I make brusque movement. With very slight retreat. These stripes must be hostile. Presumably very mild attack.

The animal resumes pure colorless as before. Colorless must be not only cryptic in the field. Presumably Pale will develop when internal organs have been so to.

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(64)

New animal is resting in posture common to:

A says that large Cuttle is still in place as before

8:21 Oscar suddenly flushes dark all over. A reaction to our approach?
Then back to colorless

A is going to change some of water and put in new food.

Now Oscar shows a dark flush when I am absolutely immobile. There is no accompanying retreat or advance. In fact, the animal also is immobile for the moment 1/3 up in water column. Apparently sound asleep. Having dreams?

Oscar certainly is not resting near surface today. If this is normal, it may be protective against birds in natural circumstances.

8:30. While I am out of the room for a few minutes, A puts new water and more food in aquarium. Oscar starts exhibiting vigorous again. With usual movements and Blob arrangement of arms.

Feeding is absolutely continuous. The animal is going continuously at tank stopping occasionally 9:03 am

10:15 A says that both cuttles are still there by the wall.

I go over to look at Oscar. Found it in cde, low dorsal fin down near bottom of tank. Finns slowly for and. Then studies at bottom. Then tentacles, I think. Apparently catches prey. Apparently after brief struggle. Then retreats up and again. Still no color change.

This type of feeding behavior might well be cuttle-fish-like.

Going away again 10:30

At noon, Terry and I go over to boat ramp where he caught Oscar yesterday. Start looking for more Oscars on boat ramp and seaplane ramp. 12:35 pm. But then I investigate nearby shoreline. P. 6 and all come to bottom. Gentle slope. And I find another Oscar right away!

Ind. is in less than 1 ft of water. Floating gently in back-down and full dark. Presumably basking in these circumstances. Definitely alone. Apparently not feeding. Arms partially in Blob.

We catch this ind 12:55 Putting it back to cde. Put (open topped) can into aquarium. Newcomer does not come out.

I shall call first ind "O" and the newcomer "OO"

After can is installed O remains in far corner for some minutes.

Ceph., July 20, 1981, V.

(45)

In "downward pointing type of head-down.
less pure colorless.

Then O suddenly advances toward can. At same time assumes down-
stroke without Fin stroke. I.E. the 2 stroke patterns are partly independent of
one another. Then assumes complete, relatively heavy, Fin stroke with Arm stroke.
At same time extends tentacles into complete Anchor. The tentacles are complet-
ely dark (no WT). When it is very close to can, it stops Anchor, turns around,
and attaches itself to the outside of the can, looking outward. Shades of young
sepiaidea! Loses stripes at approximately same time. Then just sits, tail to
can, with downward pointing Blob. Sometimes Blob is re-
covered that it looks almost like E

After some minutes, it turns a little more until it has its
side pressed tight against wall. As if stuck.

When I look inside the can, I see that OO is doing same thing.
Longly in colorless. But with dark smudge or "sheld" on front part of
back. Perhaps also a separate smudge toward rear of back (difficult to distinguish
from ink gland). Also partly protected under indentation of can.

OO probably is larger than O

Both animals still sitting in same positions 2:05 pm.

ADDITION: I noticed that the sheld was near the surface. There were also
visible miscellanea of leaves floating at surface. This was all in dark water
cryptic. (Leroy thinks that O probably was colorless when he caught it. I agree.
He saw the shadow before he saw the animal.)

2:12 I look into can again. O is entirely colorless at 1. It then
Darkens progressively as it moves. Darker on top of head from a dorsal
"streaks". Vg. A's sketch yesterday. This includes part of Petalio's dark
smudge front of back. Also separate smudge toward rear of ink gland.

2:15. O leaves can. Starts to swim around a little above top of can.
Must see O down below. O immediately assumes strong Arm and Fin strokes
in HD. With extreme Anchor, tentacles very dark. Then backs off. Arm
less colorless. A few minutes later, looks into can again. And again assumes
strokes and dark Anchor. Then goes further on. Presumably colorless and starts
muzzling. Apparently undisturbed.

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(66)

As far as I can tell, from a few brief glimpses, it stays the same throughout this sequence. Still with smudges.

I look up after writing these notes to find that O has returned and attached itself to the outside of the can again. But now it is dark, upside down, and facing inward!!!
Rather like a woodpecker!!!



O gradually gets lighter over the next 5 minutes or so. But it has not yet (2:35) resumed full colorless.

What is the significance of dark and semi-dark in these circumstances? Is it coincidental that the animal is attached to a dark (bright red) part of the can now? If it is colorless, it was attached to a light (white) part of the can ???

Then O moves to another red part of can. Here it attaches itself in a more "normal" position, tail in, arms down, but still retains semi-dark. 2:40 pm.

O doesn't seem to have changed at all.

O moves itself and swims around can. At first still in semi-dark. Then changes into colorless when it gets to white part of can! (Note: the can is Borden's). Continues swimming. Several times goes colorless is interrupted by tail stroke and/or arm stroke and/or dark anchor.

Then O goes feeding in colorless again. Still in normal.

3:18 O swims around can again. Dark near red, then goes colorless near white. Then settles on white. And assumes that is the position. Here the posture was that I called "upside down" (and compared to woodpecker) although my earlier description would seem to have been wrong. At least now, the end.

is not upside down. The back is on top. Only the arms are held up in a sort of curl. (The posture is so difficult to be right in center of side of

This posture may be some sort of sessile organism.



of color better, as if means to display. (The eyes seem fixed. Not noticeably high or low.) will be optimum. Memory of

Could the animal also be catching micro-organisms in this position?

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67

The arms often are slightly spread and moved about a little

3:24. A starts to swim. A swims stripes, then dark when I move. Then back to colorless again. Starts nibbling again.

OO still the same. Why doesn't it start to move? I am going to tip it out, leaving can in tank, 3:50 pm.

Both inds. go dark immediately. OO retreats downward toward corner. Assumes "Upward Curl" (as shown on preceding page, but probably more exaggerated) as it goes. O follows at a distance. In sort of E. Tentacles retracted in both Upward Curl and E. General effect of arms is still rather Black. Like in spite of current etc. OO reaches wall. Clings to it sideways. Motionless. At which point, O seems to lose interest. Also goes colorless. Then goes and nibbles at another wall.

These animals certainly do not seem to be gregarious now!

NOTE: "Colorless" of OO is yellower than that of O. Yellow may be low intensity dark. But OO has lost its smudges.

OO seems to be quite paralyzed with fear or shock at the moment, but O seems quite relaxed.

3:58. O goes and hangs in head-down, with both Arm and Fin stripes, near OO. OO just looks at it without changing color. Then O loses stripes but continues to hang in colorless, looking at OO intently. Then moves away and feeds again.

OO remains plastered to side of tank. Head up. Tail down. Arms raised (only slightly curled now). I think that it is the only side that is pressed to wall. In any case, this side has broad dark brown stripe down center. For all being, color may also be becoming darker toward. Animals are becoming stupider.

Everything very dull 4:04.

A movement of my hand starts OO into swimming down in E-type posture (not necessarily reticulated). Full dark all over. Then goes slightly lighter. Into turning semi-colorless with Fin and Arm stripes and a broad dark brown Median Strake on back. Strake is pretty interrupted 2/3 back. Obviously a difference of anterior and posterior "smudges." Then it suddenly starts to feed. Nibbling with Fin stripes, but not Strake, while semi-colorless becomes somewhat lighter. It blebs frantically, but only for a few minutes.

While this is going on, O is floating quietly in pure clear colorless on other side of tank.

I may be wrong. Median Strake may be on back. See latter comment.

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(68)

Then OO stops feeding. Floats passively, head up, arms more or less horizon-
tal. Median striae is now more broken, perhaps more diffuse,
than earlier.

Then O starts to swim out from wall. Assumes
both stripes and Black Anchor in HD. Snaps tentacles
back abruptly. This does look like feeding. (Is Anchor "investigatory"?) Then
goes over to middle wall. Far from OO. OO still does nothing.

Then O goes back to can, attaches itself by the tail, and then assumes
semi-upward curl, all in pure colorless. Facing away from OO on opposite
side of the can. The 2 animals probably cannot see one another.

All very quiet again 4:30 p.m.

No change 4:45. Stopping observation

Back ca 5:15 p.m. in order to add some fresh water. Find O attached
to end of can and in dark. OO is just where I left it. Also much the
same in color. But Median striae is paler and even more broken up.

5:25. OO suddenly leaves wall and advances toward can. With both
arms and Fin stripes, usual (for it) tanning background, tentacles extended
(perhaps dark but apparently no Anchor). Median striae is strong again.
Come ca:
Then settles on can (red part) in same pos. Then

Raises arms. Almost like a polyp



Note: finned is relatively
very large but quite
transparent and
very muscular

While this is going on, O is
quietly feeding, in usual colorless,
some distance away.

NOTE: A says that the 2 cuttles by the seawall here were still aroun-
nd at mid-day and shortly before sunset.

8:54 p.m. Go over to look at O. Both seem asleep. Both in
Dark. Both attached to surfaces by tail. OO near bottom of one wall. O near

July 20, 1981, VIII.

69

top of burrow

Palau,
July 21, 1981

Go to look at Oscars 7:10 a.m.

Potti still alive. Swimming around in clear colorless. OO attached to bottom wall.
Median stripe
an End ??

In general tawny buff "semi-colorless"?
Is this tawny buff perhaps the beginning of

Then (while) am writing, OO swims over and attaches itself to inside of beer can. Now apparently in lighter semi-colorless.

ADDITION: when Henry was chasing O in order to catch it a day ago, the animal tried to escape by swimming out to deep water, not by hiding in crevices.

OO comes out and attaches itself to inside (end) of can.

In tawny buff, without Ann stripe, some 10 stripes, definite Blob (this may be resting posture of can). Swimming in colorless a few inches away. Then I sweep off at 7:40 a.m. slightly, but it retains both stripes.

O now attached to outside can (white) in colorless. O is out of sight of OO.

OO's Blob is coming on.

Everyone is awake, OO protrudes and retracts (colorless) tentacles.

Not very rapidly. Could this be cleaning?

Arms really pretty spread. Looks like folded (unfolding) type, mechanism. Potti 2nd stripe and Ann stripe beginning to disappear now 7:27. But then they come back again, strongly.

OO certainly older than O. Is this a matter of age?

OO now has small spot of dark front center of mantle. Possibly a low intensity indication of smudge (?) = Median stripe (?)

Then OO rises to and surface in H2. Goes from clear colorless.

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(almost as clear as O) with Fin stripe and small back spot. Then goes dark all over when I move. Tightens again. Goes into slightly tawny colorless, with back spot, no Fin stripe, starts to feed by nibbling units. Then hangs head-up attached to wall in semi-dark.

NOTE: This back spot may be "permanent." Could it be a scar or an internal organ showing through?

Stopping temporarily 7:42

Come back 8:05 to find both inds attached. O in colorless white part of can. OO in dark on glass wall. Both be now. Then O goes swimming and Then OO goes colorless. Without back spot. O attaches to white part of can, in colorless as usual.

O goes swimming again. Immediately OO develops Fin stripe. 8:20. As a reaction to me or to O, OO develops DM. Two eyespots on either side middle of back. These may, perhaps, extend back to form a semi-Midriff Bar (ye stripes extending to or toward belly). Then goes dark all over. Then relaxes in slightly buffy colorless. All without moving. (And it's certainly invisible to O.)

O is feeding quite frequently, but OO apparently is not.

NOTE: A says that the clothes have gone from wall.

A photos Oscars 8:42

Both animals swimming around 8:45. O in colorless. OO in colorless with back spot. This spot is small, circular, sharply defined and reddish.

A puts in new fish 7:05. He wants to feed.

Sitting out to look for Oscars in the wild 1:05. In I is going down.

Walking along sand-strings-rock beach near all but sea MMDC and Harbour. Start 1:20. Notting pertinent by 1:45. I go on.

Arrive boat ramp 2:00 pm. Tide is too low to be dead. Some more action on Monday. But probably no more than yesterday. Lots of debris around.

Set group of 4 small animals which look like Oscars. O is in dark. Unfortunately, they turn out to be fishes when I finally catch them.

Over to area where O caught yesterday. Apparently no spores. But there certainly are bits and pieces of debris which look remarkably squid-like!

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Stopping 2:30 p.m.

Stop by lab 2:50 on my way back. O swimming in colorless. OO attached low to wall. In buffy with back spot.

A found some secrets today. SAN.

Cuttle still gone from seawall.

Back to lab. 3:45. O and OO attached to different walls. O in colorless. OO in pale buffy with faint back spot. Both swim. Not together. OO nibbles. Very active. O "jiggles" up and down in head-down. OO does not change general tone during feeding. But red back spot is conspicuous now.

OO assumes Fin and Arm stripes when I move. Then releases and loses stripes.

The fact that the 2 inds. never come together indicates active avoidance. But there are no conspicuous evasive movements.

O starts nibbling. Still "jiggling". Why? It is probably by quality of water as OO is resting calmly now.

O flashes away when I move, but without color change.

Then OO starts feeding again. And goes colorless except for back spot. It is mostly nibbling. But 2 apparent strokes into open water. This ind. tends to swim more or less parallel to wall while nibbling. O is usually more perpendicular to wall.

Another fast retreat by O without color change. It seems to have stopped stripes as well as dark during "normal" daytime activities.

The 2 inds. are feeding as far apart from one another as possible. Color difference between them (buff vs. clear) is essentially unvariable.

It is amazing that we have seen only 1 sign of fight (by O on first day) by these animals in captivity. Probably a (rather) difference from other species.

O extends tentacles, straight, before making long distance strikes at wall. Still jiggling madly.

O gradually moves along side wall. Still nibbling in colorless. OO is now attached to end wall, in buffy with back spot. Obviously appears less within an inch of OO. Remarkably little reaction. All that happens is that OO goes more in significantly colorless (only a slight tinge of buff, and back spot, now missing). O moves farther away. And OO goes back into super buffy.

O appears less again, and OO goes lighter again, but only momentarily.

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The 2 animals are almost touching now. But there is nothing more in the way of a visible interaction.

O moves off and OO becomes buffy again.

O finally goes and attaches itself to can. Colorless on white. Breathing slows. Stopping observations 4:30 pm.

ADDITION: Leroy saw a third Oscar today. At boat ramp ca. 1:00 pm (i.e. some time before I arrived). Alone in dark. In shallow water. This habitat may, therefore, that this habitat is "typical" for the species at some stage of its life cycle.

Palau,

July 22, 1981

The Oscars are still alive and apparently well 6:40 a.m. O swimming and feeding in colorless. OO attached to wall in buffy.

OO shows both stripes when I approach.

Then O passes close by OO in the course of feeding. OO responds by going colorless again. This must be significant. Then OO resumes buffy when O passes on.

Is colorless cryptic? Yes. Perhaps the animals assume either colorless and/or dark in order to be cryptic according to the ambient illumination (in addition to physical environment).

O certainly feeds much more frequently than OO.

ADDITION: A went touring with Marcia yesterday. Found some Lepiota. SAN.

OO still not moving 7:00 a.m. Could it be damaged?

I put some fresh water in 17.12. OO still attached in buffy with stripes. Then suddenly starts nibbling activity. First goes colorless while retaining stripes. Then loses stripes and goes almost pure colorless.

Perhaps the buffy of OO is just a "resting" coloration.

O is not feeding at the same time as OO. It just sits, attached to wall in colorless.

OO gradually gets buffy-er as feeding continues.

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O's breathing gets much slower and slighter as it rests. No real jiggling. NOTE: Octopus does not use buff as a resting coloration during the daytime.

Stopping observations temporarily 7:22

Two cuttles back at seawall. Probably the same 2 inds seen the day before yesterday. Same sizes. In almost same places as before. Smaller is in cryptic mottled neutral. Larger is in dark with white papillae. Neither is moving visibly. (Unfortunately, visibility is not too good, as there is gas on water.)

There is a big school of sepiots near surface 150 ft away. In dark. Becki starts jerking them right away. They go for the shrimp here automatically. Turn dark and dark when caught.

Only one, or at most two, inds. go for lure. same (tapping). No jiggling even when there are two. Quite sepioida-like.

NOTE: Becki says that the 2 cuttles were here yesterday.

Going for coffee 7:40

Back to lab 8:40. Both O and OO attract to wall in head-up position.

→ Only a few inches apart. O in buff, OO in colorless, as usual. OO drums Arm and Fin stripes when I approach. We put a new food. O starts to feed in colorless. OO does not feed.

OO apparently relaxes. Lose stripes while not moving (buff). And now I see that it has little or no back spot. Certainly no red patch. Perhaps a faint small smudge of dark in same area — doubtless an internal organ showing through.

Then O comes to rest only a few inches from OO. No reaction by either animal.

Now OO is showing Arm stripe without Fin stripe.

Everything replaced 8:55 am. Leaving.

We go out in the boat later this morning. To Ukukthapel again. Start on inner side and then work along outer side. 10:15 am - 1:45 pm. Weather is good. Tide is high.

The results were not so good, however. We did get occasional glimpses of sepiots from time to time. All more or less close inshore. Usually over

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sand and/or coral. But all the animals were spooky and impossible to work on. (NOTE: most of this coast looks absolutely pristine. I doubt if the squids are hunted intensively by human beings at these particular sites. The spookiness of the animals must be due to other kinds of predation.)

The most interesting observation was in a sheltered bay at 11:20. A caught a glimpse of a group of Sepiots. Over sand and coral. 2 of the inds were large. And both showed Hudniff Bar. (This may be the first "real" sign of courtship or other sexual behavior that we have seen at Palau this trip.) SAN.

Later on we investigated another sheltered bay. Very gradual slope leading up to a "rock slab" beach. The physical environment looked ideal for Oscars (a sort of natural boat ramp). But we did not find any Oscars, although we looked carefully for quite a long time. Why? I did notice that there were lots of substantial sardines around. Plus one small Barracuda. And, in the shallow part of the shallows, a mass of small, long-jawed halfbeaks. (Even though they were small, all or most of the halfbeaks were at least 3 or 4 times as long as 50.) Any Oscars in this area would suffer great risks of predation (and probably intense competition too).

On our way back, we stop at the boat ramp of Korr Harbour. Tide is still low, but presumably coming in. Again, I fail to find Oscars. But I do notice that there are very few sardines (and only very small ones at that), and nothing larger and obviously predatory.

Back to lab 4:55 p.m. Oscar swimming and feeding in colorless. CO attacked to wall, head up, in buffy.

OO first shows thick blue and fin stripes when I approach. Then goes dark all over (at least on upper surface). Then returns back to buffy with stripe. No central or red back spot. But there is a trace of a DM-like spot on one side. Confluent with the fin stripe.

O continues feeding non-stop. GO being approached by OO. Who goes slightly paler, approaching colorless, as usual.

O is also showing a marked tendency to feed and to hang out at the same end of the tank as OO. This is a change.

Leaving 5:10 p.m.

Go to look again 8:00 p.m. When I shine the light on the animals,

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I find that they are both, O and OO, in Dark or semi-Dark. And both apparently swimming (if only as a result of disturbance).

This at least goes to show that O still has functional chromatophores.

Palau,

July 23, 1981

The Oscars are still alive @ 5:58 am. Both attached to wall near bottom. O in colorless. OO in buffy.

O starts swimming. Again in same end of tank as OO.
COMMENT: I have been thinking about OO's change from buffy to colorless when O comes very close. Could this be an "invitation" or "acceptance" signal. An indication of the absence of hostility ???

When I move about clumsily, O often makes sudden fast retreats. Without color changes, except, occasionally, trace of stripes. OO continues attached but shows strong Arm and Fin stripes (these are quite distinct but not absolutely straight in outline). Also p in buffy. At least one, Fin stripe is expanded at center of body to form DM spots. And the 2 DM spots are connected across center of body by a distinct Mudriff Bar. There also is a faint trace of another Bar further back.

Double DM
with Bars



6:23. I look up from my writing to find OO attached high on wall. The head-up and full Dark. What provoked this? (Visual generally relaxed over next few minutes.)

OO does not seem to have any back spot today.

6:43. OO is hanging in buffy with stripes as usual. Then suddenly swims across tank, turning colorless, and starts to nibble vigorously. Then attaches in double DM with Bars and stripes. Dark arms are slightly flared.

Then feeds again in colorless.

O is startled by a movement of mine, and jets backward, inches without color change.

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OO is still feeding vigorously. In colorless (with only faint and brief flashes of buffy).

Then attaches in steady buffy again. With Arm stripe. I also attaches in colorless, but not absolutely clear (a slight tinge of buffy is visible).

8:30 A takes many photos.

Then OO starts feeding again. Again going colorless or semi-colorless.

NOTE: Even when swimming normally, forward or backward, the arm bundle is always blunt, not pointed. Not But

9:00 a.m. While I am putting food into tank, OO assumes a particularly dark Bar pattern (doubtless transitional to full dark). Definitely 3-Bar. Midriff Bar dark and broad (DM, faint, is obscured). Rear Bar somewhat less extreme (although fins are dark chocolate brown). Third Bar is anterior, near front edge of mantle. It is the faintest of all.

NOTE: I think that stripes persist, or are combined with some or all Bar patterns.

Stopping observations 9:10 a.m.

Back to lab 10:30 O attached, arms up, in colorless. OO feeding vigorously in buffy and semi-buffy. The 2 inds. are not close together. Then O goes to feed, in colorless, at opposite end of the tank from OO. OO attaches. O continues to feed. No color changes.

NOTE: almost all attaches now - arm head-up, but soon, arms raised. Raised arms sometimes slightly curved. An attached animal always faces away from the attachment surface.

OO has Arm stripe but no Fin stripe while att'ed.

Put in branch of coral 10:55, while both animals are at opposite end of tank. No conspicuous attention.

11:06 O is now resting attached laterally, slightly head down, with arms raised, in colorless.

Then starts to move around.

Before then goes to feed other end tank. Apparently goes to coral. Then attaches itself to wall. Again laterally, slightly head-down. Arms slightly raised but not curved.

Perhaps the 2 inds. do have slight individual differences in preference for

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resting positions?

OO does a little swimming. Then feeding. Both in colorless. This must, I think, be a sign of increasing tameness and self-confidence. Feeding is all rubbing. Anchor seems to have quite disappeared. Was it only a nervous tic ???

OO goes buffy from time to time while feeding. I can't see the releasing stimulus.

Both inds. feeding actively now 11:45. Neither has approached the coral. They certainly are not "courageous"! Presumably out of caution.

I finally does approach coral 11:50. Comes within an inch of several branches. Moves HD in water column. Buffs, extends tips of tentacles. (Are there chemoreceptors?) But no color change. And then goes back to rubbing from walls of tank.)

OO is attached in buffy again. But quite horizontally.

Arms certainly are slightly (not too slightly) spread (and curved inward) by both inds. during resting periods.

Everything very dull, everyone asleep. Going to leave 12:10 p.m.

Walking toward town 12:35. Tide is going out. But wind is rather rough. Nothing of interest at front sea wall. At the boat ramp by 1:00 p.m. Tide (still) much higher than on previous visits.

Quite a lot of small sandhoppers now. But nothing else of interest. Go on to area by plane ramp 1:25. Nothing. On to a small sea wall. Then back to boat ramp again. There is a big explosion among the sandhoppers a few yds away. Obviously there must be some predator, fishes around.

A blue and black banded sea-slug appears!

Then see 3 of the little squid-like fishes in tight group.

Water is getting rougher and sunshine is only intermittent. Packing up 2:15.

Back to lab 3:50 p.m. Situation much as usual. Attached and feeding in colorless. OO attached in semi-buffy with colorless arms.

Fin shape, when not beating, is:

In this connection, it may be worth noting that OO's fins are absolutely invisible now while it is attached to wall. Quite transparent.



5:15. Resting OO suddenly wakes up. Turns colorless. Starts to swim. Protrudes tentacles halfway. Darts across tank and apparently catches prey in water. (Its eyes are open even when it is asleep!)

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NOTE: Arcadio finally found Sepiots today "Courtship", copulation, egg-laying - the whole bit. SAN.

Back at lab. Again I notice that arms are slightly spread and incurved in attached resting postures.

4:45. O is now attached to coral itself in light. I assume that the dark is an indication of some anxiety at using a new substrate. → In Dark. Why? The coral

OO starts feeding again. Again goes semi-colorless. O, still attached, is getting lighter. OO attaches again, and goes buffier again.

Still no trace of red back spot.

Stopping observations 5:15 p.m.

5:25 p.m. Bruce finds large group of Sepiots just at seawall. Difficult to see. But reproductive behavior in full swing. Lateral Jellies, Bilateral Jellies, "flares", Sawing (or Gold), extreme darks, etc.

Could this outburst of behavior be due to the fact that Bruce has stopped fishing today ???

ADDITION: According to A, the animals that he observed here today were behaving like the lemoniana of Guam. I.E. this population, probably lemoniana too. Is the species widespread in the Indo-Malayan region?

Go back to look at Oscars for the last time 8:23 a.m. Find O attached, in Dark, to white part of beer can. OO, on the other can, is attached to coral. At least by the time that I find it in light, it is buffier. Both ends back-up with arms raised.

No sign of luminescence.

Palau,

July 24, 1981

Out to seawall 7:00 a.m. Tide low. Very calm.

Find group of 23 Sepiots uncoordinated. Same place as last night. In the general line. They graded in size. Large on one end. Ranging from small and thin at other end. All in semi-dark. No WS or RA or other just swimming back and forth, first forward and then backward.

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Some indication of 2 sub-groups, larger inds. vs. smaller inds.
also indications of at least 1 pair.

Larger inds. move off, leave smaller behind 7:06

Find 11 larger in inlet. Several inds. are lighter than dark, with broad diffuse stripe down center of back. Not a typical WS but probably related. Perhaps a preliminary indication of possible courtship, but the animals are swimming calmly enough now 7:15.

Then find whole group of approximately 23 reunited in front of seawall. This does not include the inlet animals. I.E. there probably are at least 35 inds. in the general area. All the animals are near surface as usual.

Inlet animals behaving as before. Perhaps some trace of unritualized Roaming among the lighter inds. One shows RL (or perhaps a scar?)

Every once in a while, an ind. advances as if preparing to feed. But I haven't seen any strikes yet 7:27.

All inds. are going pale - wh with trace(s) of diffuse WS now.

Wall animals still in dark. One ind. goes slightly lighter, retreats before another with conspicuous, rather thick, BB. Group on the whole scattered and relaxed. Then more active. One ind. Pales front of arms with extreme Y. Again notes one ind. in only semi-dark with conspicuous BB.

Sub division into 2 sub-groups still evident.

Another ind. with conspicuous Y and RL (definite) NOTE: Y in these circumstances must be intraspecific.

Brief retreat by whole group in semi-pale.

One ind. with both BB and Y simultaneously.

One shows semi-lateral flick swimming backward toward another. Both are large. Then retreats. Another rather somewhat large does first lateral then bilateral flick swimming backward toward another. The latter is in dark and does brief flare. Another, in dark, does extreme flare, in dark, when another ind. also in dark swims above it.

Then flares must be ritualized. I suppose that they should be considered to be low to moderate intensity displays.

Animals in inlet as before 7:53. One trace of lateral flick by a large. One lateral flick type pattern more common in this species than in

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sepioidea?

I take a break 8:00 a.m. Back to seawall 8:10. Squids still there. Calm.

One large "flashies" conspicuous narrow WS.

Suddenly all retreat without changing color.

8:17. Andree sees one of the wild Sepiots take a sardine.

NOTE: Marcus says that there is at least 1 Cuttlefish farther down wall.

One wild large, rather isolated, goes into pale-ish Ovd with diffuse WS and conspicuous White Fins as it swims backward toward other members of the group.

Several other inds. go lighter than dark from time to time. All these lighter colorations show a tendency toward tan/gray.

One ind., very large, in semi-tan/gray, shows flame, with white arms with black spots. I.E. a trace of Z. Perhaps as extreme as it ever gets in this species?

Back to seawall. One medium goes goes rather bright tan/gray all over.

Well! Well! Well! 8:30. Suddenly a rather large cuttle (greenish, at least half grown) appears. Swims in a straight line, rather high in water column (which is still low) within 2 ft of squid group. Cuttle is on the purple side "Ovd" on side of body toward seawall (and me), perhaps slightly darker on side toward squids. The cuttle seems to pay absolutely no attention to the squids. The squids are all in dark at the time. They all turn to face the cuttle as it goes by. But absolutely no color change. No retreat either. (One fairly small ind. even advances a few inches toward cuttle. Curious?)

The cuttle looked like a battleship by comparison with the squids!

One Sepiot, rather isolated, flashes Jawing. Why? Reaction to passing fishes?

Largest ind. of all is at end of line. Ovd not obviously purple.

Wild squids as before 8:45 Very placid.

Back to seawall. (Again) one ind. flashies narrow WS, only on inner part of body. I can't see either stimulus or effect.

NOTE: all these animals are remarkably sedentary. Especially with certain G. are not engaged in egg-laying now.

The 2 sub-groups of the wall animals seem to be separated now. Or, rather, the sub-group of larger has disappeared. And I see many large blobs of ink where they used to be. Unfortunately, I didn't see the incident.

Taking a break 9:00 a.m.

Ceph., July 24, 1981, IV

SD

Go to look at Oscars 9:50 a.m. They seem to be fine. Attached opposite walls. O in dark, arms curved down. OO in buffy.

OO swims and feeds in colorless. Then re-attaches to wall in Buff. O goes over to coral, and attaches in semi-dark (Note: this is not particularly true - rather different from Buff of OO - described "granulated").

Spend my time changing water, giving food, and sketching. Finish last of chores 11:25. Both animals begin to feed vigorously. Rubbing (only arms used, not tentacles). Also in water column (again apparently using only arms). Then they bump into one another. Accidentally? Stimulated by OO? OO immediately retreats and attaches itself to wall in colorless. OO continues feeding in semi-colorless with distinct dark smudge center of back near part of body.

Is this indication of Median Striae? I think so. Is Median Striae relatively aggressive???

NOTE: No trace of red back spot at any time today.

Taking a break 11:35 a.m.

Signet group is still at sea wall. Still dark and dull.

Back to lab 12:55 p.m. O swimming in colorless. OO attached in buff. Then OO swims around in semi-colorless. With short Amber.

Very dull. Everyone back to sleep again.

Then OO swims in semi-Buff and rubbles. O swims in colorless. Both jiggling. OO loses semi-Amber. Then resumes it again. This does look sensory or exploratory.

OO attaches to coral in colorless. Under projecting limb. Later moves in Buff when I move coral. Comes back. Reattaches in colorless. Moves away in Buff again when I move coral again. Then goes hunting in semi-colorless. Rubbing back bottom (buffy).

Leaving 1:48 p.m.

Going to look for Oscars by old farm, leaving 3:15 p.m. Tide is going out. Much shallow coral rubble beaches. But current (especially from under bridge) is strong.

Stop 4:15 p.m. as light is getting different.

NOTE: A visit to Pelelieu today. Covered a great variety of habitats, including Turfite Grass, without seeing a single squid. The distribution of Lycoteuthis certainly is difficult to figure out (at least on a small scale).

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NOTE: We must not forget acknowledgements. Including Birkeland, Frankie Cushing, A. Malilay, C. Gondeand, Noah Idichong.

Palau,
July 23, 1981

Both Oscars still alive and apparently well in tanks 7:00 a.m.

NOTE: We have been using Fritz-Zyme #2 "salt-water helper", from Fritz Chemical Co. P.O. Drawer 14040, Dallas, Texas 75214, to control ammonia in the water (it converts ammonia to nitrite - algae eventually convert nitrite to nitrate).

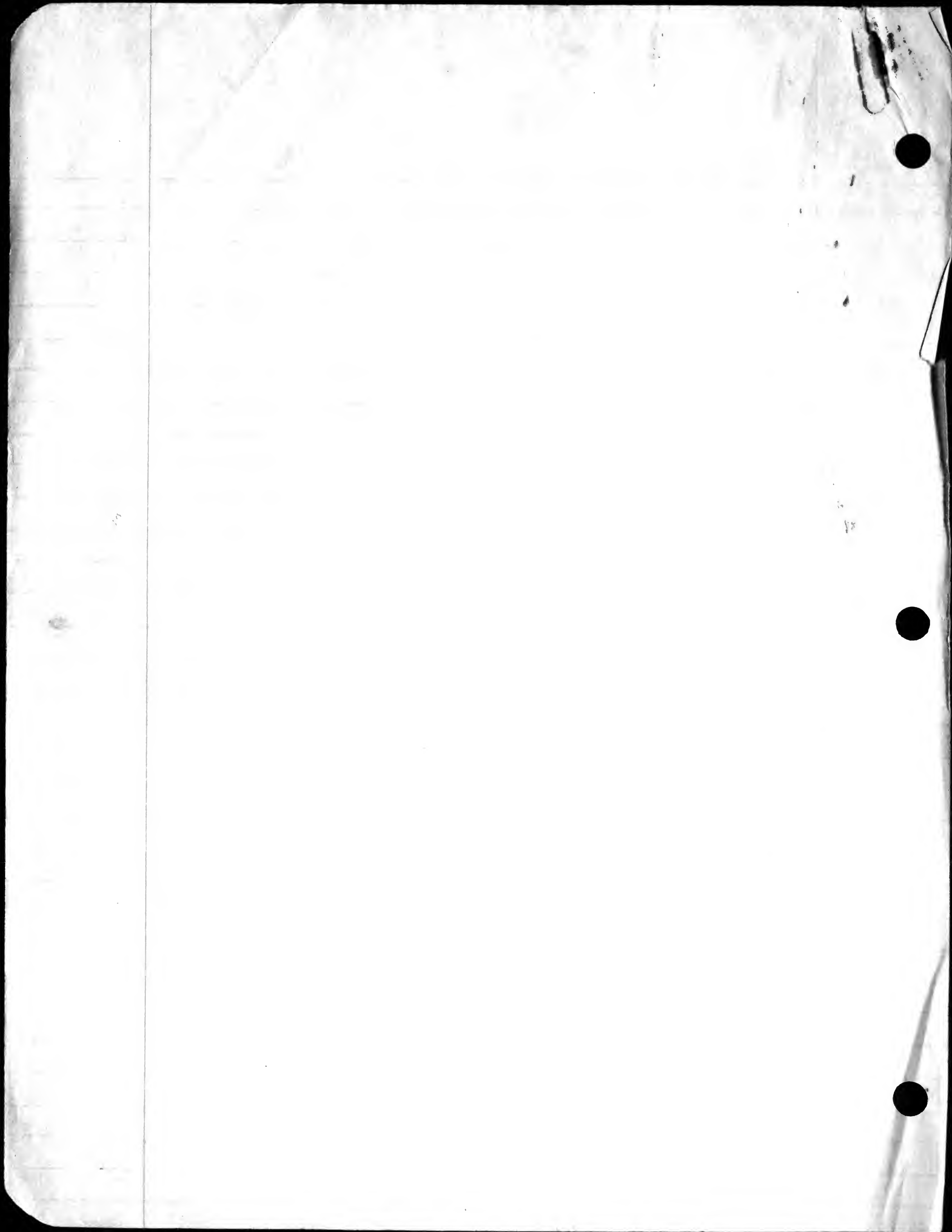
OO darts away in full dark when A drops pipe in tank.

No great burst of activity when food is put in 7:20. OO attached to coral in semi-dark. O attached to wall in very faint trace of dark.

OO has something black attached to base of arm w/ass. Could this indicate that mass is sticky?

Everyone still sound asleep 8:03 OO swimming beneath net of coral. Only head and arms visible from above.

Stopping 8:25 a.m.



Cephalopoda

Negros,
Philippines,
November 10, 1981

Arcadio has been here for approximately a week now. He has seen some Cuttles and some Sepiots which look like the forms of Guam and Palau. Nothing very exciting so far.

Today we try a "new" area. The beach of Jolison in the Township of San Jose, Negros Oriental. Weather is sunny and windy.

We go into water 11:08 am. Arcadio and Carlo swim out into deeper and more open water in the general direction of Cebu. I stay behind in the shallows.

I explore quite a bit of shore line, sand and rock, moderate slope, and also explore dock piling, floating debris, and offshore posts of coco palm trunks (for some sort of fishing net?). Looking for O's and Sepiols. Unfortunately water is murky, due to wind. I finally give up at 12:04 pm, without having seen anything of interest.

A + C make 2 trips to their (same) deep water site. They don't see anything on the first trip. On the second, however, they find a single Cuttle (perhaps a ♂ waiting for a ♀?). They also observe an encounter between the cuttle and a group of Sepiots. Sepiots appear to be curious. The Cuttle ignores them. SAN

NOTE 5: Apparently the O and OS individuals died last July, the day that I left Palau. The 11 were given to a group of NMNH on a Sunday, for delivery to Paris.

Early this morning, we went to the fish market. Bought examples of at least 2 spp. of squid (Loligo and ? Teuthis). These will also be sent to Paris.

ADDITION: Arcadio saw some other squid a few days ago. Again SAN

Cephalopoda

Negros
November 11, 1981

Go to a new area today. South of Dumaguete City (yesterday we went north). A beach called Crathon in the township of Malabanan.

Do lots of swimming several hundred m. off shore, without seeing anything but ink. Then A + C do a dive. See 2 Cuttles and some Sepiots. Little or nothing in the way of interspecific reaction. A gets film sequence of one Cuttle. SAN.

NOTE A thinks that Cuttles may be mimicking pufferfishes.

COMMENT: It would appear that the local Cuttles here and at Palau are little gregarious, during the daytime, apart from reproduction. Why? Of course, the Cuttles probably do not need to cooperate in hunting. Perhaps they also are so large that they are immune to most predators. Or does their type of crypsis preclude aggregations?

NOTE: A also found clutch of Cuttle eggs. In relatively shallow (2-3 ft) water. This seems to be shallow for Loliginidae.

Negros,
November 12, 1981

This morning we go to a place called Lag-it, in the Olut area, in the district of Bais City (and on the island of Palong Bako ~~is~~ connected with the mainland of Negros only by a bridge over a mangrove swamp or creek).

Cario says that he saw very small squids (or cuttles) in very shallow waters (a few inches to 1-2 ft) in the mangrove near here some time ago. We think of O. sepia or even young Loliginidae (the genus is supposed to be pantropical).

Around 7:45 a.m. C immediately begins to look for the animals. No luck (water is quite murky). Then we go over to the opposite side of a small bay. C looks from 10:15 am to 12:15 p.m. Again unsuccessfully.

In the meantime we talk (via Franton Alcala) with a local

woman who seems to be knowledgeable and intelligent.

She says that that the small animals usually found in the mangrove have a "skeleton". This would suggest that they might be infantile or juvenile Sepia. As far as I know, such habitat preferences have not yet been reported for the young of any species of the genus. She also mentions that such animals are often left "stranded" in pools after the retreat of high tide. Either as single inds. or as small groups of 2-3 inds.

A few minutes later, the same woman adds that there is a second type of small cephalopod - apparently a squid - which is found along mangroves, along other kinds of coast, and (?) further out in the bay. These seem to have a special name. ? "Talosoo" ?

In any case, both types are caught by the local fishermen. We will go to the local market early in the morning the day after tomorrow.

NOTE: Cervo's "real" name is DIOSCORDO INNOCENCIO.

W. J. J. J.
November 14, 1981

7:15 a.m. Check Bais City market. Squids not in stock yet. Go on to village that we visited the day before yesterday. Nothing to see now.

Back to Bais City market. Some Sepiote. Then we buy, in great success, one small Sepiote-type, one rather small Sepia (which might just conceivably be different from the large form that A has been photographing) and one rather small Talage-type. All for Pop.

NOTE: these animals probably were caught by swimming in either North or South Bais Bay.

Then Lao-tu gets another small Sepiote-type animal.

We leave 9:40 a.m.

Then go on to Tuzay market 10:05. Lots of Sepiote but nothing else.

NOTE: the Tagalog word for squid (and cuttle?) is pronounced "Nokoo" but seems to be spelled NVAOS.

Cephalopoda

Guam,
November 19, 1981

85

Start out rather late this morning. Weather is peculiar. Very gray and hazy. Rather like the outskirts of a typhoon, or at least an approaching tropical storm. But almost no wind.

9:30 a.m. Small enclosed channel by Piti power plant. We walk along sides. No squid visible. But then we see a large octopus in the middle of the channel. Swimming backward, with arms in 2 "V-bundles" trailing. Apparently more or less dark all over. A says that this octopus is being accompanied by 2 "pipefish". Coincidence? In any case, the animal moves several m. and then settles down on bottom. Still apparently "dark" or "dark mottled". Then it "flashes" some color changes. Lighter patches on arms? As a reaction to a nearby goatfish???

A goes into water to try to photo. But octopus disappears immediately. Probably into hole.

A swims back and forth along channel. Certainly no reports or catches.

10:10 a.m. I am walking along edge. Suddenly see tiny animal in 1'-3' of water over rocky ledge at shore. This might well be an O. The animal seems to be in medium dark "buffy" or "Oad" (+?). Swimming rather energetically but erratically back and forth. No very obvious feeding movements. In fact, by the time that I can get my (wedding) glasses on, the animal has disappeared. Gone out into the channel, and/or under the ledge, I think.

Then we go on to Gun Beach (Munua Bay region). Start into the water. Tony runs into a rather large octopus almost immediately. It takes up and then clamps down on a rather small rock. It does not show much coloration (largely white flecks against a "flushed" background) at the same time. It holds its ground even when Tony and I approach within a foot or so. Finally, Tony picks it, and it slides away into a crevice. With little or no change.

Then A and T go swimming outside reef. I cannot follow, as my mask has collapsed. They see only one deposit. Finally start back 12:30 pm. On the way in, I see octopus in more or less same place as before. But it disappears before A can get back to photo.

Cephalopoda, Nov. 19, 1981, II,

(86)

COMMENT: Both the octopi seen today were remarkably bold and exposed for the daytime. Is this because light is so dull today?

In any case, there is pouring rain - and rumors of typhoon by early afternoon. And then some clearing up in the evening!

Palau,
November 22, 1981

Back at the MMDC on Malakal.

Weather has been bad recently (tropical storm Irma on Guam, heavy rain here last night). Partly sunny early this morning. But tide is high at dawn. Also windy. Impossible to see anything from beach at

Starting out toward harbor, to look for O's, 9:00 am

Some trouble getting to ramp in Malakal boat ramp. Very tight beach on Sunday. Finally arrive 9:40. Sunny. Tide quite far down now. But considerable swell. As usual, a fair amount of debris.

No squid visible at boat ramp much to my surprise. I saw nothing visible.

A few seaduns around.

Probably one brief glimpse of an O (in O's) 10:45 am. But none else.

Stopping 11:20 am. Tide coming in.

Palau,
November 23, 1981

Going out in same direction this morning. Water is a little calmer now. But there may be rain later.

Start out 7:30 am. Try to work along shore, but it is too rough. Finally arrive boat ramp 8:50. Here it is much calmer than yesterday. (Wind has shifted from W to S.) And the water is pretty much clear, no oil slick. Tide is only half down.

The boat ramp is much better.

Going off to town 8:20 am

Cephalopoda, Nov. 23, 1981, II

(87)

Starting off again 9:45 am. It now sunny. Wind moderate by MND. Arrive boat ramp 10:00 am. Tide is rather far down, but not all the way.

Perhaps - just perhaps - one brief glimpse of an *O* almost immediately. In 6" of water over concrete. Darkish at first; then turns quickly paler or transparent as it retreats into deeper water.

10:30 The plane ramp is even worse than it was earlier this morning.

NOTE: I have just talked to the local Meteorological Station. They expect strong gusts (from Guam?) this afternoon. It is interesting that *O*'s seem to be less common here than in July, in spite of the fact that the weather is windier now. This might suggest that the animals observed in July were not "blown off course".

Tide is quite low 10:45.

This is ridiculous. I am leaving 10:55 am.

Go swimming along lab breakwater 3:35 - 4:05 pm. Water is murky. I don't see a thing.

Palm,
November 24, 1981

Out to NMDC breakwater 4:30 am. Sunny. The wind has gone and clear. But no squid by 8:00.

Try again 8:35 - 9:05. Still nothing pertinent.

NOTE: According to Becky, the squids have been around by the seawall, at least from time to time, recently.

Going on to harbor. Arrive boat ramp 11:00 am. Still sunny. Horribly hot. Water is calm. Tide is moderately down. (Low tide is 12:15 pm today.)

Working both ramps alternately. Still quite a lot of "green" in the water.

But no sign of squid. Leaving 12:15 pm.

4:20 pm. Back to harbor for one last look. Tide is high now. Water calm but with lots of debris.

4:40. Back of plane ramp. Flooded gravel beach. The sun is hidden, rather squid shaped object in water. Scoop with dip net. And the animal or object suddenly changes color and disappears. What in the world was it?

Rain coming 4:45. I stop work.

NOTE: Malakal Harbor seems to face slightly W of S. Bordered by Rock Islands on one side. Port installations and more Rock Islands on the other side. And open mouth of the outer reef (presumably cut by ship channel). This would suggest that the O's probably do not come from mangrove.

Guam,
November 26, 1981

Sunny but quite windy today. We go straight to Fall Channel (the main, "outer", channel in the lagoon). This is calmer than most areas.

We go into water 9:00 a.m. A found a clutch of Sepia eggs here a few days ago. Under a sheet of corrugated iron on sand and rubble bottom. In perhaps 10-15 ft. of water. SAN. He checked the clutch again today. It is still there.

A also found a pair of Sepia in area a day or two after the clutch was laid. They looked as if they might have been "guarding". But they seem to be gone today.

We swim around for a while. Tony sees groups of what he thinks are very small squids. 20-25 inds. Rather high in 5-10 ft. of water. If Tony's identification is correct, there probably are more likely to be young Sepia than O's. We try to catch one of these animals, but we fail.

Out of water 9:30.

Lorenzo
November 28, 1981

The local "Sepia" is a species of Euprymna. Apparently common. (Unfortunately) nocturnal. Already being studied. Social-burying behavior. Big student called Andrea Novak (spelling?). We all of looking for it some time night, if the weather improves (apparently it has been blowing hard for a week).

Cephalopoda

Kauai,
November 29, 1981

The specific name of the Euprymna here probably is scopelus.

We started looking for the animals at 7:30 p.m. In the shallows by the mainland dock for the marine station. 8"-3' of water. Sandy bottom. With rock and/or small clumps of coral in some areas. Wind and current (from open sea) strong. We found approximately 25 animals within 1 hr 30 mins.

All the inds. captured were near surface. All essentially aloe. Sometimes light, sometimes dark. Probably (?) usually light (colorless?) before entering beams of light.

Apparently drifting with current. Appearance probably deceptive to some extent. No attempt at mimicry. (Attempting to mimic?)

One ind. certainly retracted in Pale and/or Colorless.

Some Inking on captures.

One ind. (not seen by me) apparently flashed greenish (bilateral - see Nicole, also Harvey) light on being transferred from net to bucket.

In buckets, inds. varied from Pale to Dark. Usually settling down on bottom in Dark.

Later on, obviously flashing from Pale to Dark and back again, according to various stages of alarm.

Still later, when transferred to tanks in lab, many inds. went medium brown when settled against medium brown substrate.

All inds. settle against substrate in any case.

Probably very much like Squilla of Kaneohe.

Kauai,
November 30, 1981

All or most of the little Euprymnas ("Eup's") seem to have survived the night. Most of them looking pretty good when we arrived 10:00 a.m.

I kept 15 inds. last night. (The rest went to Andrea)

They are kept in two large tanks (2' x 4'?). 5 or 6 all inds. in

one tank with only 3" of water. 2 small inds. and 3 larger ones in tank with 4"-5" of water. Both tanks aerated, with continuously flowing water. Tanks are made of wood. There is a miscellany of pipes, rocks, clumps of dead coral on bottom to provide some shelter.

Smallest inds. are hardly longer than O_3 , although they are considerably plumper. Largest inds. are considerably more than twice as large.

All or most of the inds. are just sitting on the bottom. I am not sure that any are actually inside the tubes or under rocks. Scattered apparently at random. Never very close together. Usually at least several inches apart.

They are sitting with arms tucked in. Tucked in more or less straight down (and back under body), I think. Not swept to the side like the figure of Leinegal.

Most of the inds. are medium brown, more or less the color of bottom wood. One small is consistently in dark. This may be a sign of damage or distress. Another small is often dark without obvious cause.

NOTE: the medium brown is very cryptic in these circumstances. And presumably assumed "grumpy" full. But presumably the animals do not have to bother to be cryptic most of the time, during the day, in the wild. According to Andree, they bury themselves in the sand with only their eyes showing.

The inds. do show a tendency to huddle along the walls. Tuck to the wall, head facing outward. Obviously just looking around warily. As far as I can tell, however, they do not press up to or against the walls like the Leinegal. No real "attachment".

We put some food (collected from beach, apparently Caprellidae) in the tanks at 10:30 a.m. No immediate response.

Some animals do move around spontaneously. Slowly. Just show subtle movements. Arms apparently tucked in as when resting.

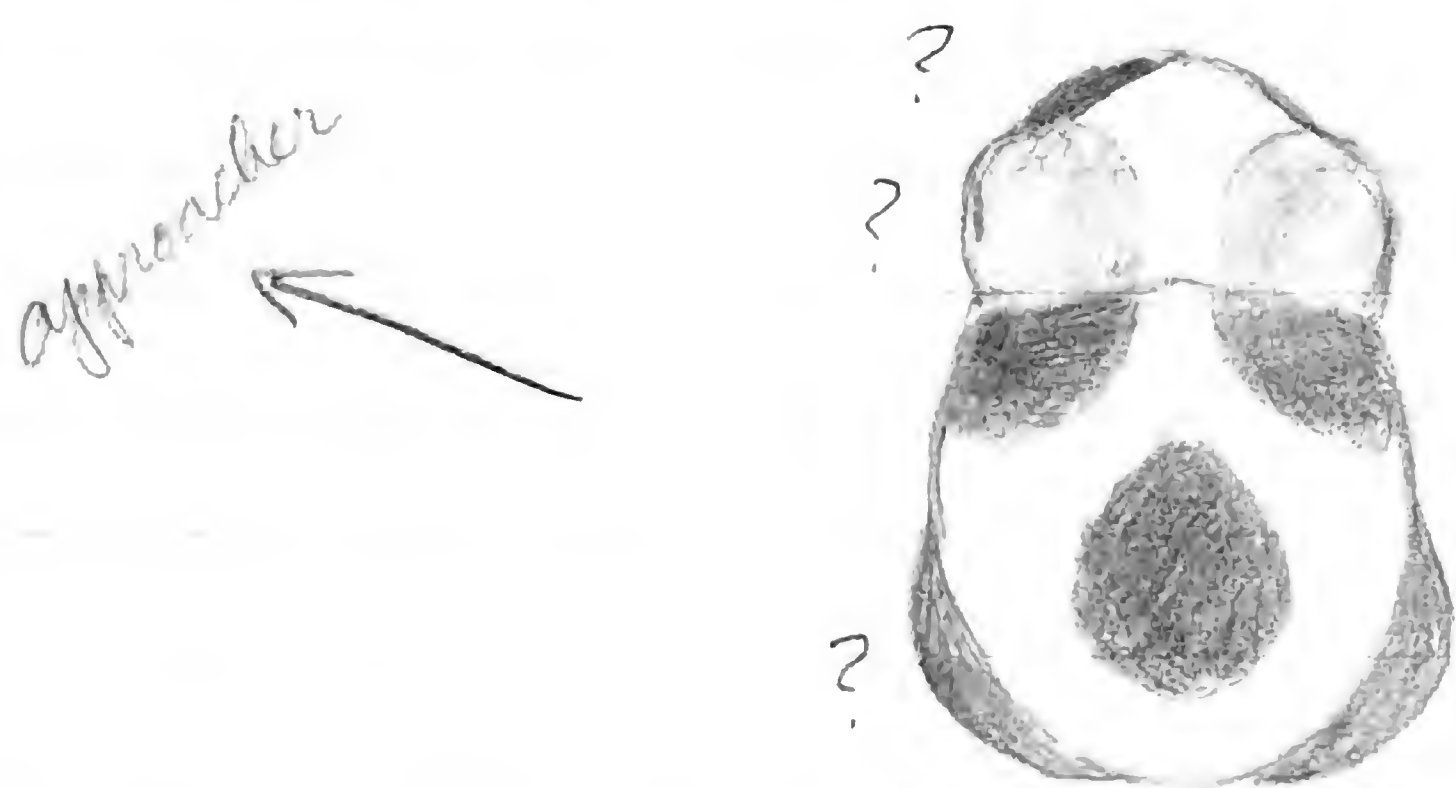
At 11:13 one small ind. moves its arms a little while swimming. This could, conceivably, be feeding. (But the animals are so small that it is very difficult to see details.)

I have intentionally disturbed 3 or 4 animals at irregular intervals. Their reactions have been rather interesting. They go dark all over when my finger gets close. (Presumably this dark usually would not be visible in the

fuld). But they usually do not retreat until my finger is almost or actually touching them. Then they retreat still in Dark. One particularly vigorous retreat by a rather large ind. was preceded by Inking. But even this ind. remained Dark throughout the incident. No trace of Pale. (Why? Could I have been mistaken last night? Or is Pale particularly high intensity in this species?)

The blob of ink seemed to me to be unusually coherent. And very much the same size as the animal. A very good "dummy" indeed.

Once, when I moved the detector, I induced one relatively large ind. to move closer to another relatively large ind. When the approacher was about 3" away, the approached suddenly adopted a very distinctive color pattern. I shall call this pattern "Dice". (More or less continuous.)



Three very distinct darkish spots on back. One central. Two anterior, on either side front edge of mantle (actually just behind eyes)

Plus blackish on or near fins. Perhaps a Fin Stripe or BE type pattern. More probably, I think a whole Dark Fin. (NOTE: the fin shape shown in drawing is not to be relied on. Real fin shape is actually very difficult to see.)

Plus conspicuous Dark on arms, at least on arm nearest approacher. Possibly just an extreme Arm Stripe. (NOTE: this may not be visible from directly above as shown in the sketch.)

The pupil of the eye was also conspicuous when seen from the side.

This pattern may have been accompanied by a trace of Dark Eyebrows. But this component was not conspicuous.

This pattern might well be equivalent or related to the DM of other species. Perhaps the two anterior spots are even homologous.

In any case, the Dice seemed to be effectively "off putting". The approacher

stopped and settled down $1\frac{1}{2}$ " - 2" from the approached

The approacher was in medium brown throughout. The approached gradually lost the Dice, resumed medium brown, after the approacher settled.

Several inds. show a tendency to go Dark all over when I shine a bright flashlight on them. (The general illumination in this room is less than dazzling. And the tanks are slightly shaded.)

One ind. - the approached in the incident described above - responds to the flashlight by turning semi-Dark all over the top of the top of the head (including eyebrows) and showing the center spot of the Dice also in semi-Dark form. (The chromatophores are quite visible in semi-Dark. A freak effect.)

Everything quiet 12:45 p.m. But several resting inds. show trace of full Dice (faint imprint) without obvious cause. Other resting inds. are still just pure light or medium brown.

Now I get a rather better view of a large ind. in a rather strong "semi-Dice". The dark coloration in or near the fins does seem to be a Fin Stripe on the body. Fin itself seems to be quite colorless.



And all the arms are all Dark, sharply marked off from lighter color of "forehead".

NOTE: Apparently Dick Young has been working on the brown type of this species. And Eric's assistant has seen them "giving" little red shrimp? Presumably in the daytime. Shooting with tentacles.

1:35. Now I see a resting large with well marked Fin Stripe with out "other" or "real" Dice components.

Two smalls resting 2" apart. One very light. The other in Dice - as yet even. The latter suddenly swims away. Moves some distance with arms flexing? In one case, turns completely Dark during movement. Then comes to rest and turns lighter.

One small has been hiding in white PVC tube. Suddenly comes shooting out. Possibly disturbed by flashlight. Quite light as it comes out. Settles on wood and turns very Dark. Then starts to move about. Flexing arms, but

not tentacles. Trying to feed on something ??? Certainly not an amphipod.

2:30 pm. Find 2 rather large ones only 1" apart under overhanging ledge of rock. Both in quite normal relaxed coloration.

Spacing does seem to be random socially if not topographically.

2:45. Try a little experiment. Take one of the larger out and put it in finger bowl. Does not change "relaxed" dorsal color when I first chase, even touch, it. But it may flash light glaucous (underneath rear). Then turns very dark and Miles when I get it into net. Turns much lighter when put into bowl. But not really complete Pale. Freckled on back and head. General effect light brown. Must be perfectly cryptic over sand. Arms are stretched out in front. But tentacles not very much longer than other arms. All the arms are completely colorless — or rather, white. Animal keeps bumping against wall in effort to get away. Also develops broad fin stripe. And lines of anterior Dice spots. This gives the effect of a broad dark band all around body.



The chromatophores are less dense, or smaller, or less expanded above the fin stripe than at the center of the back. Thus there is an ill-defined light (yellowish) stripe above the fin stripe. There is no trace of Dark Eye lines. Orange-red center spot.

Several times the animal shoots up to the surface of bowl. Apparently aiming at me.

Anterior spots soon disappear. Fin stripe gets gradually fainter. Animal folds arms underneath. They become yellowish freckled at same time. More or less like back. And they are splayed out in a fan-like figure.

This continues for some time. Animal gradually relaxes a little. Still generally freckled. But arms go white again. Still in various positions. Folded underneath, with or without splay. Also stretched out in front, in variable contorted patterns, from time to time.

Put the animal back in tank 3:00 pm.

COMMENTS: I suppose that the "freckled" is the color of the species. And perhaps the species has a "complete" Pale. The "white arms" are only a partial Pale. Perhaps "obscure" ???

The species certainly is less visible than any cephalopod I have

ever seen. Presumably this is correlated with the sand-burying habit.

Everything very quiet indeed 3:25. Certainly no sign of an evening "awakening". Of course,

Still no trace of activity 4:30 pm. I start to pack up

Kauai,
December 1, 1981

Arrive back at lab 9:00 am.

Find one small dead in shallow tank. But the other 4 smalls in same tank are still alive. And there are at least 8 inds. still alive in the other tank.

Unfortunately 3 out of the 4 remaining in the shallow tank are more or less Dark. This may be a bad sign.

We put in lots of brine shrimp. According to John Shear (Purdue Univ's student), these are not the kind of shrimp that the Eups like. Certainly these animals do not seem to like them. The small Eups simply move out of the shrimp's way. Retreating with little or no color change.

Some time later, we notice that many of the Eups (but not all) are literally covered by the brine shrimp. It looks as if the shrimp are literally stuck to the Eups. Are these eups covered with sticky mucus in some cases?

Anyhow, we try remedial measures immediately. Set up another tank (approx. 20 ft long), with patches of very light colored sand at one end, and transfer all the surviving Eups (14 inds.) to it.

Several inds. go Dark all over when being chased by net. At least 2 of these inds. also eject ink. Again I notice that ink is particularly cohesive, forming a blob of approximately same size as the ejecting animal. (Blob also moves about quite actively in these tanks with their dividers and tubes of incoming water.) Other inds. go semi-Dark, and/or show Fin Stripes (often or usually continued forward by traces of anterior spots of the semi-Dark type.)

When released in the new tank, all the Eups except one settled on bottom immediately. The exception was a particularly vigorous large, which swam away from me actively. (Obviously it could see me clearly). All the inds. settled on the sand, or soon moved to a sandy area.

The settled inds. retained the color (Dark or what have you) they had assumed before hand for some seconds or minutes after settling. But they all, sooner or later, assumed the color of the sand. Much lighter than the medium brown favored in the previous wood-lined tanks. Very finely mottled, again just like the sand. At first I thought that this color was due to the fact that they had become covered by the sand itself - presumably adhering to the mucus. But the changes in all or most cases, occurred before any of the inds. began to actually bury itself (see below). So I suppose that the change was a real alteration of the color (and perhaps the texture ???) of the skin. Wonderfully cryptic.

This is a species that has specialized in cryptis.

Every once in a while, I would stick a finger at a settled Eup. This would induce retreat. Obviously very reluctant and/or sluggish retreat in most cases. Sometimes without color change. Sometimes with a change to semi-dark. Sometimes with Fin Stripe + partial anterior spots (I call this combination "Ring". The active large ind. retreated in a "freckled" pattern like the one seen yesterday. This Freckle obviously ritualized as such. Very different from the cryptic sand color. More yellowish. And the spots - the actual freckles - are much larger, darker, more sharply defined.

I think that the Freckle of this ind. was accompanied by at least a trace of Fin Stripe or Ring.

The Freckle presumably is at least moderately high intensity. Perhaps with relatively less alarm than full Dark ????


Several inds. retreated briefly in the full cryptic sand coloration above but with very dark, almost black, arms.

All inds. usually swim with arms pointed down. Usually also tilted backward. I could not tell if this was a distinctively ritualized E or not. (Perhaps the species always swims in this posture when it is not proceeding at full speed?) Thus the Dark Arm pattern combined with cryptic sand coloration was hardly visible except from the front. Was it disruptive? And/or was it an expression of high intensity Dark which had to be masked by cryptis to view from above.)

All these patterns seem to be primarily or exclusively interspecific anti-predator devices.

It may be significant that there was little or no trace of the full Dice during any of this catching and chasing. The full Dice may be intraspecific. Shunt.

I suppose that the center spot of the full Dice may be strictly homologous with the "dark dorsal shield" and similar patterns of (other) squids.

After some seconds or minutes after settling, and after having assumed the sand coloration, all the inds. began to bury themselves. This began with strong, almost convulsive, backward (or backward and downward) lunges or pushes of the body. At (not entirely regular) intervals of a few seconds. Lunges usually continued until almost whole of body embedded in sand. Only top of head, eyes, and (at least sometimes) upper front part of mantle remained exposed. Then the animals began to throw sand on top of themselves. Using tentacles. Tentacles spread wide midline.  Then brought together or toward either in front

or backward

Pushing and flinging sand as they go.

The final result was remarkable. The animals seemed to disappear completely. Even the eyes seem to go. Either the eyes are really buried. Or they are partly closed somehow, so that the pupils appear as nothing more than tiny specks, indistinguishable from the sand.

Do these animals have eyelids ???

After all the animals were buried, we turned out the lights and left for lunch. Came back about an hour later. Peeking carefully with a flashlight, I find that two of the smaller inds. have emerged and are resting on the sand. Apparently still sand-colored.

REFERENCE. "The Biology of Marine Animals". By J. A. Colin Nicol. Published by Sir Isaac Pitman & Sons, Ltd. London. 1960. Illustration of (young) Euprymna morsei on p. 421. Diagram of light organ of Sepiola ligulata on p. 558.

I must also check E. N. Harvey "Bioluminescence". Academic Press. New York. 1952.

Fins of Euprymna shown in Nicol as:



The animals are left in the dark again.

When we look again, ca. 2:30, more of them have emerged. Some have moved far down the tank, away from wood. All apparently sitting rather than swimming. All show a tendency to turn darker in flash light.

Ca. 3:30. As before. Perhaps even more individuals out. But at least 2 large are still buried. When I disturb one, it used one tentacle to throw a little extra sand on top.

One large is sitting on wood in Truckle. Doesn't seem to be disturbed (but, of course, my light is shining on it). Could Truckle be the "Ord" of the species ??? If not, does the species have a real Ord in the Leptoteuthis sense.

3:45. I put a few Leander shrimp in tank. Everyone agrees that the Eups like them. But no one launches to pursue my meager contribution while the flash light is on.

But then - about 15 mins. later - I see a large Eup resting on wood (in fact, the "Truckled" ind. noted above) - suddenly rush forward from the substrate, shoot its tentacles, and presumably catch some mouthful prey. I observed this under wondrous natural light. As far as I could tell, the animal captured its prey without any conspicuous change in coloration. Presumably Truckled throughout.

4:00. Bob Ross (one of the graduate students here - from Guam) produces many more Leander shrimps. 70+. We release them into the tanks. And then turn on the lights.

Four minutes later, I try to take a survey. At the far end of the tank are 4-5 small Eups resting on wood. Dark or semi-dark now that light is on.

At the near end of tank, all the inds. that are on top of the sand bury themselves as soon as the light comes on.

4:10 One of the inds. at far end of tank suddenly floats up to near the surface. Quite small. Still in Dark or semi-Dark. In HD with arms curled below. My impression is that inds. of this species assume "HD" relatively frequently. Again when not moving rapidly.



or even



Some writhing of arms. Is this feeding?
On "cleaning"? On what?

Ca. 4:20 we turn the lights back on. There is a great burst of feeding. Presumably on the shrimps brought by Ross.

Most of the feeding is by more or less large inds. which had been buried in the sand beforehand. They lurk in the ground, suddenly launch themselves forward or forward and slightly upward. Then they shoot forward with the tentacles.

Now I see that these inds. do have sand glued to their backs. Small grains and even tiny snail shells. The effect is almost Ankylosaurus-like. A complete carapace on back. Also on top of head. (Of course, I can't see the undersurface of the animals.)

During the shooting, the tentacles seem to be more or less dark. Presumably an indication of anxiety. The animals may well be dark or semi-dark all over, underneath their carapaces.

The animals bury themselves in sand again between attacks. Same burying techniques as before. But usually the animals do not go completely under. Eyes and top of head definitely above surface.

Tentacles are colorless or sand-colored when they are used to gather and throw sand.

The carapaces are naturally cryptic. Of course this is cryptic against predators. It is also very cryptic against prey. Even a prey with good eyesight must be taken by surprise when a piece of the substrate suddenly launches forward in an attack.

Do the Eups feed this way in the daytime in the wild?

4:33. I put another pile of sand in the far end of tank. One of the snails which has been in dark or semi-dark moves over and settles on sand. Gradually goes sand colored before burying itself. To my eyes, this coloration is almost or completely as cryptic as a real carapace.

What controls the formation or accumulation of a carapace? Is the secretion of mucus facultative or voluntary???

Just to recapitulate the situation as I know it now..... All the larger except one ind. (the Hatched ind.) have been buried in the sand.

All the ones that I have seen emerging to feed have had complete carapaces. There also is at least one small ind. buried. I have not seen it emerge yet. I suppose that it would have a carapace too. The rest of the smalls and one large are not, and probably have not been, buried. Of course, they do not have carapaces.

Interestingly enough, these exposed inds. do not have attached brine shrimps either. (And there are plenty of brine shrimps in this tank now.) I.E. They have not been secreting mucus. Why?

I do not think that the secretion of mucus can be "abnormal" or a sign of poor health. Some of the animals with carapaces have been feeding actively. (At least one ind. made 3-4 strikes in a period of 5 mins.) The "frickled large" without carapace has also fed at least once. And it looks bright and alert even when just resting.

It would appear that the species has alternative strategies.

NOTE: Even the accumulation of attached brine shrimps -- whether voluntary or not on the part of the Eups -- could well have been adaptive. The accumulated mass certainly disguised the shape of the animals.

One of the smalls outside the sandy areas leaves the bottom and swims up toward the surface. Hangs in a sort of head-down position with arms curled and spread in a sort of E-like arrangement. In dark (still).



There does some writhing of arms. I have no idea of any of this is ritualized. But it is my impression that more or less head-down postures are common in the species.

NOTE: One of the graduate students here, Frank Stanton (spelling?) looked in on the Eups last night. Found 2 of the large inds. clasping one another, front to front. According to Reese, Frank says that they showed "not spots" at the time. Perhaps frickles? Could this have been copulation? In any case, the animals did nothing more while the light was shining.

Cephalopoda.

Kaneohu,
December 3, 1981

I talked to Andrea again yesterday.

Apparently the formation of carapaces of sand is quite typical of Eups.
See also abstract of paper by Lingley.

According to Andrea, the Eups also have a type of V pattern. Tentacles raised with tips curved down.

She also says that John Arnold thinks that the species is a seasonal breeder. October and March. See also his own paper of 1972 in the Veliger.

She has seen some of her Eups feeding in the daytime. Like the animals here the day before yesterday.

She says that the large ones here are approximately adult size. She also reminded me that we caught 3 of the larges in quick succession in a limited area. Could this have been a courting party ???

Today we arrive at the lab ca 9:30 a.m. The tank seems fine. But not a single animal is visible. Presumably all buried. And quite thoroughly. I can't even see eyes or funnels. (Note: The lab is on an automatic light schedule 12 hrs on 12 hrs off. Changes at 6:00 a.m. and 6:00 p.m. Thus the animals have been exposed to light for several hours already.)

10:30. Found small ind. sitting on top sand. Complete carapace head and back. I poke it. It swims out and settles on wood. Of course, no color change visible. The animal just sits immobile. Moves a little when I break surface of water with magnifying glass. Sits again. Then moves around of its own volition. Usually only a few cm. at a time. One larger movement of 10 cm + largely crabwise. Then sits again. Still on wood.

Then I put some brine shrimp in tank. The animal ignores them. But then it swims directly, head first, to patch of sand 20 cm. away. Sits. Then advances of few cm. Apparently seizes something very small on surface. Larva? Uses arms or unextended tentacles. Then retreats a few cm. Sits again.

Did the animal emerge because it was hungry? Was this spontaneous feeding?

In any case, it disappears while I am writing. But then I see what is probably


another, slightly larger, wid. 10 cm away. Head and upper back emerging from sand. No carapace on these parts. Skin medium brown. No freckles visible. The animal just sits and looks for some minutes. Then surfs back, uses tentacles to throw sand on head as usual.

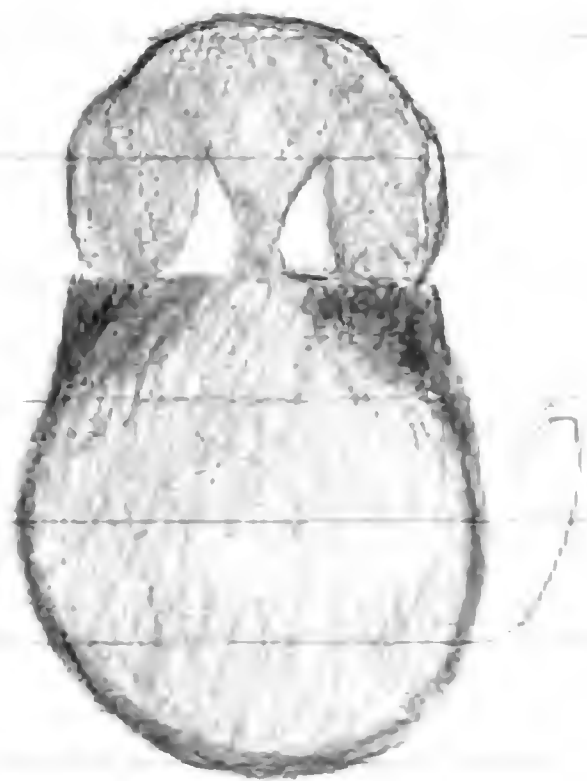
After writing this, I return to find that the animal is no longer there. But there is an wid., probably same wid., on wood. In semi-dark. No carapace. Fairly conspicuous. Wid. gradually lightens a little until it reaches wood. Sets. Then swims over to sand. No color change. Suddenly shoots out tentacles and apparently catches prey in water column. Then settles on sand. Still medium brown. Very conspicuous against light sand (but not in the environment as a whole - where there were many scattered spots of both light and dark).

Then the animal begins to feed more actively. 4 strikes and 1 abortive attack in the next 5-10 minutes. All at prey in the water column. I can't see the prey. Presumably very small. I can't tell if the strikes are successful or not.

Colors are characteristic and stereotyped.

Between attacks the animal remains more or less medium brown. And I see that it also has Ring, superimposed upon the brown. Anterior spot components are relatively large and conspicuous (Note. The Ring apparently is never quite complete. There always is a gap in front).

The animal has something like a "Y"  Very diagrammatic. Two light yellow spots. At first I found it very difficult to determine precise location of these spots. Finally use magnifying glass. Then it appears that the spots are adjacent and medial to rear part of brow ridges. Perhaps extending a little bit up sides of ridges.



I am not sure of shape or position of fins.

Again very diagrammatic. Y spots may be too close together (eyebrow ridges may be drawn too round). Individual melanophores (or clumps?) are visible, distinct, at least on back, when viewed close up. But this probably is not "real" freckle.

Fins seem to be quite transparent and colorless. This may be true in all Dark and Dark related patterns. (But the fins probably do have some melanophores. See photos in Arnold.)

Arm bundle is extended well before (some seconds) before actual strike. Commence



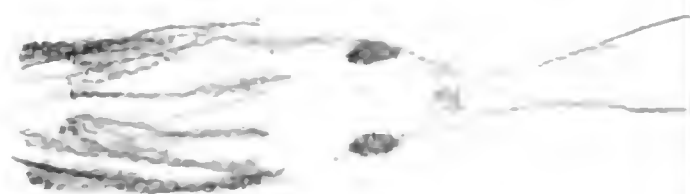
At the same time, or just as the strike begins, the animal turns noticeably lighter in color.

This presumably is a kind of Pale, but it is not nearly as exaggerated as the extreme Pales of other species.

Once the animal went first Pale and then Dark during strike.

Finally the animal makes another strike and seizes Leander. Shrimp is large. Probably $\frac{1}{3}$ - $\frac{1}{2}$ the length of the Eup. The latter hangs in water for some seconds after capture. More or less some Dark Arms splayed out in irregular fashion. Moving. Sometimes contacted. Presumably grappling with shrimp. Then straightens out in tube. And now I can see that the shrimp is being held lengthwise, head out.

The shrimp is gradually sucked in and devoured from the tail up. As soon as it can, the Eup closes its arms over the front end (mouth parts) of the whole shrimp. Presumably breaking off mandibles at the same time.



I can't tell if the shrimp is paralyzed or struggling. Certainly turns or is turned partly sideways on several occasions. But it is always held very firmly indeed.

Finally the whole shrimp disappears from view within the arm bundle.

Then the Eup abruptly throws away (the presumably empty?) cephalothorax (or the front part thereof). The Eup rests on the (wooden) substrate for some seconds. Then swims, first tail first, then head first, to sand. Settles. Buries as usual.

So the species is willing to feed in the daytime even when not starved.

The process of feeding took at least 20 minutes.

There were a few slight color changes during the process. The animal remained more or less brown throughout. With Y and Ring. But toward

But toward the middle of the meal, the background color of the back became lighter. Quite yellowish. And apparently more strongly spotted (perhaps a trace of "real" Frackle?). At the same time, there also was a trace of the water spot of complete Dice. But this faded out fairly soon.

When the animal finally swam over to sand and settled, it did not go sand-colored before burying.

Everything quiet 1:30 pm. But there is one small (the hungry ind.?) resting on top sand. With complete carapace.

Buried again by 2:00 pm.

Nothing more of interest in afternoon. All I can see is an occasional carapaced head peering out.

5:20 pm. Poke one small ind out of sand. With full carapace. Retreats very reluctantly and slowly. Only for a few cm. Arms dark at first. Then legs yellowish brown (unspotted). Ind settles on edge wood and sand. Sets.

The lights finally go off 6:10. The ind. that I had disturbed immediately goes back to sand, settles. But other inds start to emerge immediately. One or two without carapaces. The rest with full carapaces. All or most inds. rest on surface for a few seconds or minutes after emerging. Then many of them start to swim and hunt actively. Some inds. lose carapaces, in patches, even before starting to swim. Does the species have an "anti-coagulant"? (It does have at least 2 types of secretory cells in the skin.)

Some inds. were buried so deep that they had to use powerful jets of water by the funnel in order to get out.

All inds. are in dark or semi-dark. Perhaps Dark-Frackle in some cases. Little or no Fin Stripe or Ring.

One small Eup catches Leander. The shrimp is not particularly large for its species, but it is substantial and probably difficult for the Eup. The Eup turns very dark and jets ink twice after the capture. Begins to eat tail first. While hanging in water. (Like the ind. this morning. Apparently prey is not taken down to substrate.)

Frank Stanton says that he saw 2 Leander taken a couple of nights ago. Both also tail first. (Probably because of antennae.)

The first inds. to emerge were all small. First large emerged 6:30 pm.

(It was our impression, the night that we went fishing, that we caught most of the large inds. relatively late in the evening. Differential tanning certainly would reduce competition between old and young.

The animals seem to be avoiding one another without fighting.

There are at least 13 inds. still alive.

After I write these notes, I go back and look again. Some animals are swimming actively. Apparently hunting. Others are resting quietly on bottom (both sand and wood). Two very smalls are dark. All the other inds. are lighter than they were earlier. Almost sand color (even on wood) some at least semi-freckled. Others not.

All inds. tend to darken if I shine light on them steadily.

Two rather medium sized inds. have silver v-shaped markings on back. Front boundary of where the center spot of Dice would be if it were present (which it is not).

I have seen these marks before.



Perhaps they are only an internal organ showing through.

As far as I can tell,

none of the inds. has T

Good heavens! Return after writing the above, to find the two longest Eups in copula. (Of course, I did not preliminarily "courtship" or "solicit" but it must have been brief - at least tonight.) One ind. is flat on ground and slightly behind. The other is above, tilted forward at an angle (and perhaps also skewed or tipped slightly on one side.) Top individual, presumably ♀, seems to be slightly larger than the bottom ind., presumably ♂.



← this angle slightly misleading. At first, the ♀ may have been less strongly tilted,

pressing down more heavily on the ♂. In any


case, ♂'s eyes are just in front of ♀'s fins. (I think that fin shape is correct in this particular sketch.)

The ♂'s back, and what I can see of the top of his head, is covered by a uniform and intricate pattern. A fine reticulation of dark brown upon a cream or light yellow pattern. Looks rather like some reticulations of Octopus vulgaris.

(I could not see any textural components. Perhaps the skin was smooth.) The pattern could also be related to the PT of sepioides.

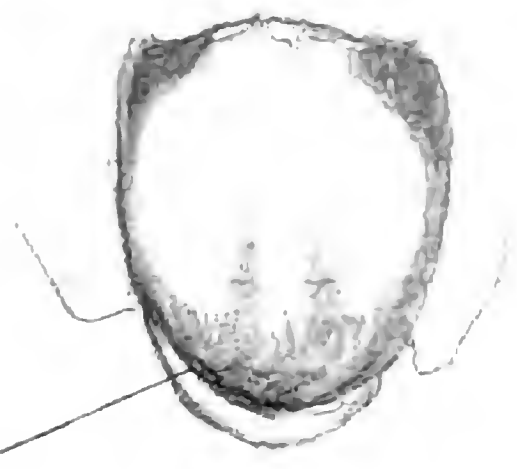
The ♀ was much more variable. When first seen her head and back were a soft uniform dove gray. This is a resemblance to sepia latimanus. With several added components. The extended arms were medium brownish (perhaps "Ind" ???) The whole rear edge of the body was defined by a sharp but rather narrow white border, which I will call "WTB", extending roughly from fin to fin.

Could this be related to the RL of sepioides ??? At least one of her fins (the one that was upper because of the sideways tip) was beating madly. Perhaps a flutter.

Some changes set in which I would interpret as signs of hostility or disgust. Perhaps as a reaction to my light. Or perhaps a (natural) reaction to the ♂ as the copulation progressed. Some black appears on the back. Beginning at the border of the WTB. First appears briefly as four lines, like the so-called "Zebra" of sepia spp.  This quickly changes to pure black. A sort of "Black Tail Border" (BTB). Sharply defined against WTB. More smudged in front. The black expands, gradually and irregularly. Into a sort of Ring-like arrangement, with distinct traces of 2 (perhaps sometimes 3) longitudinal smudges or blurs toward rear. There or less comme ça



anterior spot also



Note this is not a Fin stripe. It is on the back, not along the side

Fins are transparent. This faint 3-stripe version has 1 central and 2 lateral stripes

Black toward rear can be even more extensive

COMMENT: The forms, although not the positions, of the WTB and BTB are remarkably similar to the WB and BB of sepioides. The resemblance is so close that it can hardly be coincidental. As I remember, the WB and BB also are associated with courtship and/or copulation. This would appear to be another case - like the DM's of sepia officinalis and Octopus

vulgaris - of the same pattern appearing on different parts of the body in different species of different shapes.

At approximately the same time that the BTB developed, the top of the head turned brown again.

Whatever caused these changes in the ♀, I was sure that my light was not helping matters. So I started to turn it off at intervals. Twice the animals moved (10-20 cm.) in the dark. Still in copula each time I turned the light on again. Perhaps copulation is a mobile process in the wild?

As it continued, the arms of the ♀ gradually curled under. Perhaps manipulating the spermatophore. At same time the rear part of her body seemed to be lifted higher.

Later still, the ♀ resumed a slanting posture as on p. 104. And her head went gray again. Possibly even her arms went gray. But the BTB remained sometimes weak, sometimes strong.

Any sideways skew of the ♀'s body which may have been present at the beginning of copulation disappeared after a few minutes.

The light of the flashlight produced some peculiar optical effects (reflections) which may have been slightly misleading; but I am fairly certain that the ♀ also showed two other patterns during the later stages of its copulation. A brilliant iridescent blue-green streak on at least one eye - for at least a few minutes. And a small silver patch in the center of the BTB which it was extensive. (It is possible, however, that these patterns would have been unappreciated in a less concentrated light beam.)

Toward the end of the copulation, the ♂ seemed to be slipping back further behind the ♀.

Finally the 2 animals separated. Of course, when I had my light turned off for 1-2 mins. When I turned it back on again, I found the 2 animals with



This may be only an approximation or guesswork. I was looking at the animals from straight above.

ing on the substrate, sand, 30 cm. apart from one another. The ♀ was already in the usual pale sandy, slightly mottled, coloration. The ♂ was still in full Reticulate. This faded gradually over a period of 4-5 mins. (As in sepioidea, the ♂ seemed to be ready to continue. It probably was only the behavior of the ♀ which turned him off.)

I began to watch the copulation at 7:10 pm. The copulation finished around 7:35. It may well have been delayed by my use of the light. But the normal copulations of the species must still be much more prolonged than those of the Sepioteuthis spp.

ADDITIONS AND CORRECTIONS. I have had a chance to speak to Frank Stanton personally. It turns out that my account of the copulation that he witnessed on p. 99 (filtered through Rees) is wrong. The cop was not front to front. Instead, the animals were in much the same relative positions as the inds. observed tonight. But the lower ind. was grasping the upper ind. with 2 arms (tentacles?). The animals were spotted. But probably with the usual brown freckles (the brown could be described as reddish brown in some lights). Perhaps this copulation included (even) stronger hostile components than the one observed tonight.)